

# DISCOVERY

## Monthly Notebook

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## Steam Turbines

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## FEBRUARY

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# DISCOVERY

THE MAGAZINE OF SCIENTIFIC PROGRESS

February 1944 Vol. V No. 2 PUBLISHED AT THE EMPIRE PRESS, NORWICH, ENGLAND Tel. 21441

## The Progress of Science

A MONTHLY NOTEBOOK COMPILED UNDER THE  
DIRECTION OF DAVID S. EVANS

### Chemistry and the Future

THE air is full of discussions of the post-war world. Scientific research is accepted as an essential element in a successful programme of reconstruction. Statements concerning the undoubted material benefits that science can bring are produced by a bewildering variety of institutions and individuals. A minority, perhaps in a desire to check the very wildest statements, produce dicta which suggest that they have no belief at all in the beneficent practical possibilities of science. The discussion enters not only those fields which are naturally thought of as the province of science, but impinges on an increasing variety of social problems. Not least among these is education, which may be regarded as the means of production of scientists and citizens of the future who will be equipped to extend the bounds of existing knowledge, and to govern the kind of world which can be built on the foundation of that knowledge.

We have to take account in considering the ways in which science may be applied to our world, not only of the material benefits it can bring, but also the less obvious but equally important contributions it can make to the business of living together in a community. These are of two kinds: on the one hand there is the undoubted value of the scientific method itself as a practical tool for the solving of social problems at all levels from the personal up to those which affect the lives and future of states and communities. On the other hand, science and scientific knowledge have a humanistic value in themselves in awakening the citizen to the beauty and charm of the natural world around us. By such appreciation, the intensity of awareness and the zest in living can be evoked and heightened.

If therefore we would see, as most scientists wish, a nation and a world filled with men and women healthy, well nourished, masters of their material surroundings and exempt from the bonds of ignorance and fear, we must acquire and develop this many-sided conception of the function of science in our modern world.

It is just this amplitude of viewpoint, the very stuff of which democracy is built, which makes the Report on the

Education and Training of Chemists recently published by the Royal Institute of Chemistry such refreshing reading. This document is rather a statement of principles than of detailed practical proposals, and it embodies a lofty and humanist conception of science which does great credit to the Chemistry Education Advisory Board which prepared it. It is the kind of statement of a cause perhaps not immediately realisable which will bring out that element of devotion to an ideal which exists in even the most hardened of us, and which in the end is the spirit which does secure practical results. It is a document which has a very general application transcending the special requirements of chemical education and will be of interest to all scientists. Having said this much in praise of the report, it should be added that it seems necessary that this document should be supplemented by one setting out in more detail the methods by which it is thought that the general principles may best be realised.

Turning over the pages, we find first a discussion of the place of chemistry in schools, and the recognition of the value of the stimulation of an interest in the phenomena of nature and in the methods of scientific enquiry. It is valuable that the statement should be made explicitly of the vitally important part played by the teacher in making or marring the best formal schedule of education.

If we follow out this train of thought we are led to the conclusion that only first-class teaching ability, and a status and remuneration for the teacher sufficient to attract first-class men and women, will suffice in the scientific education of our future citizens for their responsibility. The mere laying down of a syllabus is insufficient. Without teachers of real daring, experimentally minded, who treat their everyday work as a golden opportunity for a scientific study of instruction, we shall not produce from our schools pupils with the wit and confidence in their own brains and skill which the modern world needs. The key to enterprise in education is the provision of enterprising teachers.

A second problem which always arises in connection with reports on training for a particular specialist vocation is that there is always a tendency to regard the whole educational system as a means of producing a fortunate minority who will earn their living in that vocation, the

remaining pupils being lesser breeds without the law whose needs must be subordinated to those of the specialists. That difficulty has to a considerable extent been avoided in this particular report, but the problem has not been completely solved. There does not seem yet to have been a complete treatment of the problem of combining in the same school courses of instruction for those intending to become scientists with courses in science for citizens in general. Our present courses are probably fairly suitable for the former class, though there is in the report a sound recognition of the need for a more general education for scientists and for the reform of the scholarship and other university examinations which have played a large part in forcing early academic specialisation.

What does need doing, and that very urgently, is that a course of science in relation to modern civilisation should be designed by real experts in science with no thought of an examination in mind. After this has been done the course should be made the basis of a skeleton syllabus within which the enterprising teacher will find room for vigorous thought of his own. Lastly, such a course must be considered from the point of view of deciding how far it meets the needs of intending scientists, and whether a supplementary course is necessary for them and at what stage.

The report then concerns itself with the training and education of chemists as it might be carried out within the framework proposed in the White Paper on Education. Here science is concerned both as a part of general culture and as part of technical training. It is most surprising that it should be stated that in the case of the non-specialist pupil practical work in the laboratory need not be required. Surely the great defect in our present general scientific education in schools is that it is too much confined to books and does not adequately instil the realisation that the world around us can be studied and controlled by scientific knowledge, gained primarily from practical observation and experiment, and only later synthesised by a controlled process of ratiocination. It seems essential that any course of instruction in science should emphasise that knowledge is to be obtained from nature and not from books, and should include laboratory work. The question of the practicability of arranging for laboratory space to be available, and of deciding the nature of the experimental work may be difficult to solve especially immediately after the war, but the principle should never be allowed to lapse.

The latter stages of the report are concerned with the various channels by which pupils may enter the chemical profession: as assistants, as semi-qualified workers and as fully fledged scientists. It is recognised that for each person there is an intellectual ceiling above which it will not be profitable to try to educate him, but the feature that is most impressive about this discussion is the recognition of the profession as a unity, together with the desirability of making available to ability means for passing from lower to higher grades after employment has started.

Thus not only are the obvious measures of continued part-time education for early school-leavers suggested, whereby they may improve their qualifications within a given grade, but in addition we find in the section on "Chemical Assistants" the words "Many of these junior workers definitely desire to adopt a chemical career and will naturally aspire to attaining some recognised grade of chemist. The abler ones will look forward to reaching

professional status." Here we have a principle which we can all subscribe to, and which ought to be recognised by our administrators as an essential measure for taking advantage of all ability available, including that which only develops comparatively late in life.

For the student who goes to a university the recommendation is for a four years' course in which the last year is specially devoted to technological subjects, with visits to industrial establishments and vacation courses in industry. Technology itself should be promoted by the establishment in this country of institutions similar to the Massachusetts Institute of Technology where post graduate technological study designed to "harness scientific knowledge to the promotion of greater and more varied industrial activity" can be encouraged and where new uses for our natural resources can be surveyed.

In a final section dealing with the supply and training of teachers their importance in the scheme of things is strongly stressed. "If our future citizens are to become imbued with the spirit of science, if they are to gain an effective knowledge of its achievements and an appreciation of its values and uses, and if the education of the future workers in the fields of science is to be built on a broader foundation, the teachers must not only possess the necessary knowledge but must also be men and women of generous training and wide cultural outlook." More and better teachers for schools will be required. For the new technical colleges instructors both in pure chemistry and in technology will be needed, and quality will only be attracted to this vital sector if rates of pay comparable with the maximum possible in industry are attainable in the teaching profession. In addition, the hours should be short enough to leave the teacher with mental energy sufficient to allow him to engage in research, an activity which can only help in stimulating his powers and maintaining his originality of mind: in short—in making him a better teacher.

So far as the report goes it is admirable, but it should be followed by one dealing with the methods of realising its admirable ideals. True a variety of committees, including for example the McNair Committee, are considering the supply and training of teachers, but would not a statement from the distinguished body of chemists who drafted this report have been noted by the Committee as a valuable expression of expert opinion? A statement on such vital problems as the future of Chemistry State Bursars, on the provision of facilities for post-graduate research, on exchange of personnel between industry, universities and government research establishments, on training of post-graduate workers for research, on financial provision for students and many others is needed. It is to be hoped that the Chemistry Education Advisory Board will now turn its attention to these practical problems, and that the liberality of outlook which marks its first pronouncement will be continued in its second.

## Jets and Rockets

THE announcement that Great Britain had in service a fighter driven by jet propulsion has excited a great deal of public interest, and has led to the publication of many descriptions of the principle on which this means of propulsion depends. It is however most unfortunate that almost without exception the descriptions have been given

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in a way which is physically incorrect, and which obscures some of the most significant features of this very important advance in applied science.

The forward motion of the aircraft as the heated gases are ejected backwards is the result of what is known as the principle of the conservation of momentum, which may be illustrated by a hoary old question from school examination papers in physics: "A man is seated on a perfectly smooth sheet of ice. How can he get off it?" All his struggles avail him nothing, for he can get no grip at all on the ice. The solution is for him to take off his boots and to throw them away, in the direction opposite to that in which he wishes to move. As he hurls the boots away, pressing against them to throw them through the air as rapidly as possible, there is a force between his hand and the boots, by which he presses himself away from the boots with exactly the same force as that which he himself is exerting on the boots. He can in this way succeed in starting himself sliding across the ice in the opposite direction to the boots, and the principle of conservation of momentum simply says that the product of the weight of the boots and their speed must be equal to the product of the weight of the man and his speed.

To acquire any considerable speed the boots must be thrown very fast. Lacking boots, if his lung power were prodigious the victim could set himself in motion by blowing out a lungful of air with an extremely high speed.

This is in fact the principle of the jet aircraft. Hitherto we have clawed our way through the air by means of an airscrew. Now we progress by ejecting a stream of gas at very high speed in the direction opposite to that in which we wish to go, the very high speed of ejection being necessary in order to make the forward momentum of the aircraft (which is equal to the backward momentum of the tenuous air forming the jet) as large as possible.

What puzzles many people is how the force urging the aircraft forward can be developed, and they have been led up the garden path by such completely incorrect statements as "the jet presses on the air behind and urges the aircraft forward". Such statements are completely without foundation. The error and the correct principle may be illustrated in the following way. When a gun is fired, the forward momentum of the shell (weight multiplied by speed) is exactly equal to the recoil momentum of the gun. If the gun were not spaded into the ground it would go

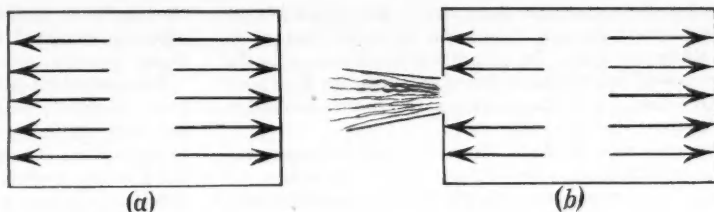


FIG. 1

backwards on firing, just as the man on the ice who fired off a pair of boots went backwards. A succession of projectiles would give a succession of backward impulses producing almost a continuous force, unless (as in the case of the machine gun) the recoil is absorbed in operating the reloading mechanism. To see how the force is developed when we replace the easily visualised bullets by a continuous stream of gas we shall have to resort to a diagram.

Imagine a sealed container filled with gas under pressure (Fig. 1). The gas presses in all directions on the walls of the container and since the forces balance, it exhibits no tendency to move off bodily in one direction or another. If the pressure were, say, 100 lb. per square inch, and we made a hole in the wall one square inch in area, then the pierced wall would sustain a smaller force (corresponding to its reduced area) than the opposite wall. There is thus a nett force urging the container forwards in a direction away from the hole. This is the reaction pressure of the jet of gas which is now rushing out through the hole we have made. So far, nothing has been said about conditions outside the container, and they certainly play no part in producing the reaction pressure. However, the faster the gas rushes out, the more efficient will be the propulsive force. If the outside pressure were, in our case, also 100 lb. per square inch, then no gas would rush out, there would be no jet, and no propulsive force. If all the external pressure were removed, the velocity of ejection would be a maximum and the jet would produce its maximum force. It follows then, that, far from pressing on the air, the jet is positively hindered in its operation by the presence of air outside, which can only serve to reduce the velocity and propulsive efficiency of the jet.

In order to make this important point quite clear a simple experiment may be described. Figure 2 shows a lever which can swing freely at one end, and on which a jet carrying compressed air is mounted transversely. When the air is turned on, the reaction pressure of the jet pushes the lever into an inclined position where it remains steady. If now a book, or some solid object on which the jet might press more efficiently (if that indeed were its mode of action) is placed behind the jet, the pendulum actually falls a little, indicating a reduction in efficiency.

The importance of understanding this point clearly is that it is now quite obvious that, provided the mass and speed of the ejected air is kept constant, the jet will be more efficient in the tenuous air of high altitudes than it is at ground level. The jet aircraft thus opens up the possibility of operation at high altitudes where the efficiency of an airscrew diminishes. The possibility of speeds greater than that of sound has also been mooted, but this is a most complex topic which cannot be discussed here. What can

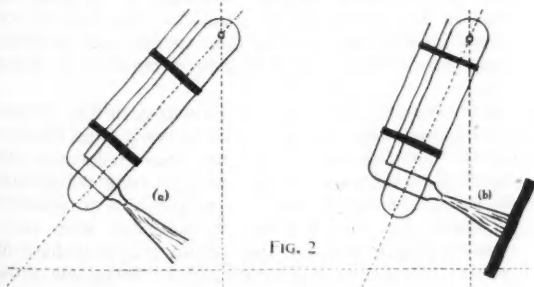


FIG. 2

be said is that it is certain that an existing aircraft cannot fly at such speeds, nor can an airscrew be constructed which will achieve this end. Jet propulsion is not subject to the same limitations, but the design of an aircraft to fly at such speeds would require the solution of design problems of an entirely new kind.

The possibility of flight in the tenuous and meteorologically calm layers of the atmosphere which is opened up by jet propulsion suggests a number of other considerations. Flight in a very tenuous atmosphere will mean a great reduction in air resistance for the same speed. However, air performs two functions for the normal airscrew-driven craft. One is the provision of the medium through which a propeller can claw its way; the other is the provision of lift by reason of the pressure exerted on the rapidly moving wings. The first function is no longer necessary for the jet plane, but what of the second? Will it be possible to use the same aircraft at high altitudes and at low altitudes during taking off and landing? The answer would appear to be in the affirmative, if the speed in the stratosphere is very much higher than at low levels, for the lift can be maintained by increasing the speed to compensate for the reduction in pressure. It seems therefore that the future of flight lies with jet propulsion, high speeds and high altitudes.

Security considerations have obviously limited the published details of jet propulsion, but from official accounts it appears that the way in which jet propulsion is realised in practice is by using part of the energy developed to work a compressor drawing in air from the atmosphere, while the remainder is used to endow the compressed air with a high velocity. The compressor is actually worked by a shaft connecting it to a turbine placed in the airstream ahead of the ejection nozzle. This drawing off of a part of the energy to work the mechanism is of course exactly what is done in the case of an ordinary aircraft engine with a supercharger. The engineering points connected with jet propulsion are very manifold and special problems arise in connection with steering and control of the new planes.

It will be seen that the jet aircraft relies on outside air as the source of its working fluid. The next step, suggesting the possibility of the attainment of even greater altitudes, is the production of the gases within the mechanism itself, by the combustion of a solid or liquid fuel. This is of course the method used in rocket propulsion. The principle of propulsion by reaction pressure is the same: only the source of the ejected material is different.

## Hashish and Assassins

THE word assassin is derived from the Arabic "hashishin", meaning an eater of hashish, the narcotic drug prepared from hemp. Quite apart from the scientific implications, the reason for such a curious derivation makes a fascinating story.

Originally the word "hashishin" was applied to the members of a wild Mohammedan sect founded at the end of the eleventh century by one Hasan-i-Sabbah. One of the essential beliefs of this sect was that the committal of murder was a certain means of entering Paradise, particularly if the murdered person was an infidel. When it is realised that at its height the order numbered tens of

thousands, its menace can be imagined, and in fact its influence extended far beyond the limits of Syria and Persia, the main strongholds of the sect.

The hashishins were organised very much on monastic lines, members increasing in importance from rank-and-file novitiates to the high-priests entrusted with all the secrets of the order. The head of the sect was the notorious Sheik-el-Jabal, which means Old Man of the Mountains. While it is possible that the sect was first formed as a result of genuine religious convictions, it was certainly not long before the leaders saw the practical advantages to be gained from complete control of an army of avowed murderers. Thereafter there began a programme of almost unparalleled looting and murder, which was ended in 1256 only by the determined efforts of the Tartars, who massacred no less than 12,000 of the hashishins. Even then isolated groups still persisted, as they are said to do even at the present time.

From the scientific aspect the interesting point is that the whole vast organisation was held together by means of the drug hashish. Preparations of this drug can be smoked, chewed, or drunk as a type of tea. The effect produced is said to be somewhat similar to that of opium, but while just as demoralising it is physically less destructive. The chiefs of the order claimed to have the divine power of transporting the favoured to Paradise, and they implemented their promises by occasionally inducing the exhilarating and sensuous "pipe-dreams" of hashish, whose secret they kept strictly to themselves. Small wonder that the deluded novitiates, certain that death would return them eternally to the Paradise whose joys they had already tasted, would gladly undertake missions which meant almost certain death.

To-day hashish is just as potent a drug as it was centuries ago, and the public knowledge of its properties has created world-wide problems. Hashish is prepared from the flowering top of the hemp plant which grows wild in many parts of Asia and in America. The tough fibres of the plant are widely used in the preparation of ropes and coarse fabrics, while the seeds yield a valuable oil. The drug itself is largely concentrated in the drops of greenish resin exuded by tiny glandular hairs situated among the flowers. Sometimes this resin is used alone, but more often the whole flowering head or even the whole plant is broken up and compressed into blocks for sale. So prepared the drug sells under different names in different parts of the world e.g. hashish (Egypt), bhang (India) and marihuana (North, Central and South America). Despite most rigorous control and the imposition of severe penalties, the trade in the various forms of hashish is enormous. In America marihuana cigarettes realise as much as £1 apiece. Modern dealers have taken a leaf from the book of the hashishins and often compel their victims to commit the most brutal crimes in their desire to obtain the drug at any cost.

Until recently exact scientific knowledge of the chemical and pharmacological properties of the hemp drugs was very scanty. To some extent work has been hindered by the fact that the illegality and secrecy of the trade necessitates the preparation of the drug by people with no scientific qualifications. Consequently preparations differ enormously in their potency, and results are often hard to repeat. It has however been possible to isolate one of the

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active constituents (known as cannabinal), determine its chemical structure and synthesise it in the laboratory. Cannabinal differs from most of the habit-forming drugs such as cocaine and heroin in that it does not contain the element nitrogen.

Attempts to use hemp preparations medically have not met with much success, and they have fallen into disrepute. For this there are two main reasons. It is difficult to assay the potency of different samples, which vary enormously, while individual variation in response is probably greater with this drug than with any other. For this reason it is hard to describe exactly its physiological effects. Objectively there is a period of excitation and exhilaration often followed by a sleep or coma. All observers agree that the effect is mainly upon the nervous system, the muscular and digestive system being largely unaffected. The drug is said to have been used in China to produce insensibility during operations as long ago as the year 220.

Various writers have described their extraordinary mental sensations following administration of the drug. Gautier describes how it seemed to him that his body had become dissolved and transparent, so that he could clearly see in his stomach the hashish he had swallowed. The friends who were with him appeared as half men and half plants, while when one of them spoke to him in Italian the hashish transposed it into Spanish. After a few minutes he recovered completely without any ill effect. Another person stated that his body appeared to become elastic, so that he could enter a bottle and remain there at ease, while yet another imagined he had become the piston of a steam-engine.

Enough has been said to show the extraordinary and dangerous powers of the drug, whose increasing spread in Europe and America is presenting a major drug problem. It is interesting to reflect that in some ways this problem, supposedly so modern, was almost as serious nearly 1000 years ago.

## Working on the Railroad

If one reads histories of the railways one finds that academic scientists were associated with their working and development to a surprising degree. That their efforts were not always models of discretion is shown by such stories as that of a certain professor who left a London terminus aboard an engine travelling on the wrong line, and who had to reverse furiously to his starting-point to avoid collision with an express. That however was very long ago, and the modern railway scientist is performing a vital function in solving scientific problems which arise in railway working.

Mr. T. A. Eames, Senior Physicist of the L.M.S. Railway Research Department, has recently described

some of this work. One of the most important war-time problems of transport must obviously be the transport of foodstuffs and their delivery in an undamaged state, and Mr. Eames describes some of the careful studies of problems of refrigeration which have been made. Clearly the great variety of freight, conditions of boxing and loading and many other factors present the physicist with problems of very great complexity. To disentangle fundamental principles from data affected by a multiplicity of causes, and to design the experiments so that the measurements have any real significance, calls for a skill far greater than that required for the mere handling and reading of instruments. Considerable attention has been paid to such problems as the flow of heat from vehicles of varied construction, to the design of insulation, and to the relative merits of ice, carbon dioxide ice and mechanical means as refrigerants.

The problem is complicated by the incursion of biological and economic factors, but as Mr. Eames remarks "The benefits derived from even the simplest of calculations based on sound analysis and measurement are great; the subject is thereby removed from the field of guesswork on trial and error methods." Here we can see yet one more example of the way in which the methods of science and the scientific approach can be of value even in fields far removed from the laboratory.

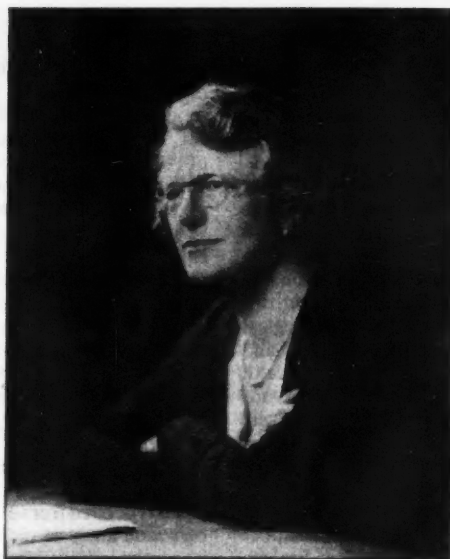
But refrigeration is not the only problem which has engaged the attention of the railway physicists. Yet another group of problems is connected with the heating and ventilation of vehicles and buildings and with the dust content of the air. Noise is another field of obvious interest on a railway, and there are some interesting remarks to the effect that the comparison of noise levels in phons does not always give an index of the degree of annoyance caused by a particular noise. As Mr. Eames remarks this is only part of the general problem of the "Amenities of Travel" which raises a large number of questions as to how far physical measurements of factors such as noise, heat, humidity and soon can be taken as indices of the actual comfort of the traveller.

Doubtless this group of problems will have to remain shelved until after the war, giving place to a special group of war-time scientific problems. Chief among these have been problems connected with lighting and A.R.P. measures, which have involved observations of the efficiency of lamps of all kinds, the transmission of glass substitute materials, the value of fluorescent paints, and the combined physiological and physical problems of the response of the eye to the dimmed permanent way and signal lights which must be used.

Clearly Mr. Eames has been pioneering successfully in a field of work of very great importance for war-time applications, and one which will play a considerable part in the development of railway transport after the war.

## REFERENCES

- Chemistry and the Future: *The Education and Training of Chemists*, Royal Institute of Chemistry, January, 1944.  
Working on the Railroad: *Journal of Scientific Instruments*, Vol. 20, No. 11, November, 1943.



## Dr. Dorothy Jordan Lloyd

DIRECTOR, BRITISH LEATHER MANUFACTURERS' RESEARCH ASSOCIATION

WHETHER there is equality of opportunity between the two sexes so far as a career in science is concerned is a matter for discussion. I do not think that equality exists yet in Britain, and it is certainly true to say that relatively few women have reached a position of eminence in any specific branch of science. For that reason particular interest attaches to the career of Dr. Dorothy Jordan Lloyd, for she is at present the only woman to have charge of the affairs of an industrial research association.

Dr. Jordan Lloyd, who has made her reputation—an international reputation—in the field of biochemistry, began her career in biology, the science which attracts the greatest proportion of women science students. The subject she took for the second part of her trips at Cambridge was zoology.

She was born in Birmingham in 1889. To study science became her ambition at the age of 12. Detached from its context that choice may seem a trifle precocious, but it is not difficult to understand why she made up her mind so soon and so definitely if one recalls the circumstances of the girl's home life and schooling. One compelling influence was undoubtedly the strong scientific atmosphere that existed in her home. Her father was Professor of Operative Surgery at Birmingham University. Her grandfather, too, had been a doctor and had held the post of lecturer in anatomy at the old Mason College, an institution that was absorbed into Birmingham University on its formation. Any talent for science that she inherited was therefore assured of a congenial environment. Added to that, her schooldays were spent at King Edward VI's High School, which had a well-developed science side. Some science was taught in every class. From the age of 12 upwards students could learn elementary chemistry. In

addition physics was taught in the matriculation class, while there was botany, zoology or physiology up to Inter.B.Sc. standard for the girls of the science side, who, it seems, were regarded by the rest of the school as a race apart, being allowed the privilege of the relaxed discipline that is inseparable from school laboratories and the distinction of wearing a laboratory overall over their dresses.

### Early Training

The science side of this school undoubtedly attracted many of the best brains, and it is interesting to note that several "old girls" of the King Edward School afterwards became well-known in the world of science. For instance there is Dr. Ida Smedley MacLean, now famous for her work on fat metabolism. Then there was Miss Edith Wilcox, who won the first Newnham College fellowship, and who later married Professor J. Stanley Gardiner. The second holder of that fellowship came from the same school; she was Miss Muriel Wheldale, who did important work in connection with the inheritance of colour in primulas, in particular with regard to the enzymes that control the production of anthocyanin pigments. The third holder of the fellowship was Dr. Jordan Lloyd.

She had gone to Cambridge University as a student of Newnham College at the age of 19. After taking the first part of her trips in botany, zoology and chemistry, she studied zoology under Professor J. Stanley Gardiner. During that time she came into contact with Dr. Cresswell Shearer, an inspiring teacher who rightly considered zoology to be the study of *living animals*, and not merely the examination of the anatomy and histology of dead ones.

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Even at this early stage her teachers, recognising that the girl's talents lay in chemistry, made the shrewd prediction that she would return to that science. Incidentally, her interests in biochemistry were aroused by a course of lectures, given by Gowland Hopkins, at that time still holding the position of lecturer in physiological chemistry.

After passing the second part of the tripos, she was awarded the Bathurst Studentship of her college, and spent the next two years doing research under Shearer's direction. Her first original researches were concerned with methods of introducing parthenogenesis in sea-urchin eggs. This work led to a six-week visit to the experimental station at Woods Hole at the invitation of Jacques Loeb, the famous American zoologist. After this, she turned her attention to the phenomenon of regeneration. For this work she used a small marine flat-worm—a turbellarian called *Guna ulvae*, to be exact—and these particular experiments gave rise to a series of investigations into the effect of osmotic pressure on living processes. On the results of this experimentation, published in a paper to the Royal Society in 1913, she was awarded a fellowship of Newnham.

The osmotic phenomena that occur in muscle formed the subject of her next studies, which brought her into contact with Sir William Bate Hardy, the colloid chemist whose pioneer work laid the foundations of the physical chemistry of proteins. She now came to the realisation that it was impossible to study the extremely complex physico-chemical process that go on in living tissues without having first gone into the analogous phenomena that are exhibited by simpler, non-living organic matter, and for that reason she now turned her attention to the colloidal swelling of gelatine.

The year was now 1914. More and more scientists were having to turn from fundamental long-term research to the thousand of miscellaneous problems calling for *ad hoc* research that the Great War was throwing up. One such problem had been assigned by the Medical Research Council (then less piously known as the Medical Research Committee) to Hopkins's laboratory where Dr. Lloyd was now working. It was to find substitute culture-media for use in bacteriology. In this war it has been agar that has been short; in the Great War it was the supply of peptones, upon which we had previously been dependent on Germany, that were cut off. The Cambridge scientists had the task of finding methods that could be used in any reasonably equipped bacteriological laboratory to prepare alternative nutrients. The team which investigated this matter with considerable success included S. W. Cole, Harold Rais-trick (now professor of biochemistry at the London School of Hygiene) and Dr. Jordan Lloyd.

At the end of the war Dr. Jordan Lloyd returned to her interrupted study of the colloid chemistry of simple proteins, and the knowledge she now gained in connection with gelatine was to be of particular value later, for leather consists essentially of chemically treated—i.e. "tanned"—collagen fibres, and collagen is a fibrous protein which is readily converted by boiling into gelatine with which, chemically, it has much in common.

### Joins Leather Research Association

It was in 1921 that Dr. Jordan Lloyd was invited to join the Leather Research Association by Dr. Pickard, its Director. Other members of this scientific team included

Mr. R. Leslie Collet (now assistant registrar of the Royal Institute of Chemistry), Dr. E. W. Merry and Mr. R. Faraday Innes (both chemists with practical experience of the leather industry) and Miss Madge Kaye, a microscopist. In 1927 Dr. Pickard left leather research to become head of the Shirley Institute, Manchester, then the largest research association in Britain. Dr. Jordan Lloyd was appointed as his successor.

Under Pickard's direction the unit laid the foundation of the microscopic study of hides and skins. This work showed how important, indeed indispensable, is the microscope in the scientific control of leather treatment. Its use enabled the fate of the collagen fibre to be closely observed at every stage of manufacture, and to-day it is realised that the microscopic structure is the basis of the physical properties that account for the desirable qualities of leather. The consumer, though he may now be aware of the fact, is mainly interested in these *physical* properties. Think of the leather used in making the uppers of a pair of shoes. Rigidity is needed, otherwise the shoe will not keep its shape; yet the leather must be elastic enough to mould itself to the shape of the foot; it must keep water out, but it must also be capable of allowing water vapour, which is continuously given off from the skin of the foot, to escape.

Since Dr. Jordan Lloyd took charge the research association has made great strides in evaluating such factors as tensile strength, resistance to abrasion, flexibility, plastic properties, and waterproofness. The work has necessitated the analysis of "quality"—heretofore a province monopolised by the leather craftsman, with his indefinable "instinct"—into physical properties capable of exact measurement, and this has entailed the development of all kinds of ingenious instruments for measuring those properties.

### Need for Industrial Support

To-day the research association comprises sixteen graduates and twelve technicians. Of recent months a campaign has been started to persuade more members of the leather trade to support their own research association. If the research unit is to extend and intensify its activities it must have more money, and in that cause Dr. Jordan Lloyd, like many other industrial research directors, has had to spare time from her scientific work to turn publicist.

Dr. Jordan Lloyd is a recognised authority on proteins. Her book on protein chemistry, a standard work, was first written around a series of lectures which she delivered at Battersea Polytechnic, and has since been expanded considerably into a second edition which she compiled in collaboration with another woman biochemist, Dr. Agnes Shore.

The importance of her work has been recognised not only in Britain but in America. She is a vice-president of the Royal Institute of Chemistry. In 1939 she was awarded the Fraser Muir Moffat Medal by the Tanners Council of the U.S.A. for her contributions to leather chemistry, being only the third recipient of the honour.

Dr. Jordan Lloyd's scientific activities leave her little time to indulge in her hobbies of mountaineering and horse-riding. She has to rest content with recollections of taking jumpers over the hurdles at the Richmond Royal Show and the International Horse Show, and with having climbed many peaks in the Swiss and French Alps.

WILLIAM E. DICK

# The Night Sky in March

M. DAVIDSON, D.Sc., F.R.A.S.

**The Moon.**—Full moon occurs on March 10d. 00h. 28m. U.T., and new moon on March 24d. 01h. 59m. The following conjunctions take place:

March			
2d. 08h.	Mars in conjunction with the moon,	Mars 6° N.	
2d. 13h.	Saturn "	Saturn 3 N.	
7d. 11h.	Jupiter "	Jupiter 0° 1 S.	
22d. 16h.	Venus "	Venus 2 N.	
29d. 23h.	Saturn "	Saturn 2 N.	
30d. 18h.	Mars "	Mars 5 N.	

**The Planets.**—Mercury rises shortly after the sun throughout the month and sets at 16h. 04m. and 19h. 43m. at the beginning and end of the month. The planet is in superior conjunction on March 19. Venus rises at 5h. 34m., 5h. 40m., and 5h. 14m. at the beginning, middle and end of the month and can be seen before sunrise. Mars can be seen throughout the earlier part of the night, setting at 2h. 54m., 2h. 28m., and 2h. at the beginning, middle and end of the month. The planet recedes considerably from the earth during the month, its distances at the beginning and end of March being 109 million and 137 million miles. On March 7d. 15h. Mars is in conjunction with Saturn, Mars being 3° 4 north of Saturn. Jupiter is visible throughout the night. The planet rises early in the afternoon and sets in the morning hours, the times of setting being 6h. 15m. and 4h. 13m. at the beginning and end of March. On March 1 the planet is 411 million miles from the earth and at the end of the month the distance has increased to 437 million miles. Saturn

sets at 2h. 40m., 1h. 47m., and 0h. 49m. at the beginning, middle, and end of the month. The distance of the planet from the earth increases from 820 million miles on March 1 to 866 million miles on March 31. Correspondents occasionally state that they find a difficulty in recognising the planets. The table of occultations will often assist in identifying a planet. For example, Saturn is in conjunction with the moon on March 29d. at 11 p.m., and can be identified from this phenomenon. Those in possession of a small telescope can easily recognise the planet by its rings.

Times of rising and setting of the sun and moon are given below, the latitude of Greenwich being assumed:

March	Sunrise	Sunset
1	6h. 46m.	17h. 40m.
15	6h. 15m.	18h. 04m.
31	5h. 38m.	18h. 31m.

March	Moonrise	Moonset
1	10h. 14m.	0h. 44m.
15	—	8h. 48m.
31	10h. 11m.	0h. 43m.

The sun enters the First Point of Aries on March 20d. 18h.

**Discovery of a New Comet.**—Mr. G. F. Kellaway, West Coker, Somerset, discovered a new comet on December 19d. 21h. in the constellation of Aquarius. Its magnitude was 6 at the time of discovery but as it was receding from the earth it is now a faint object. The comet was also independently discovered by Peltier, an American astronomer, on December 17. Mr. Kellaway rediscovered

Comet Daniel on November 30, from the position given in the *Handbook of the British Astronomical Association*, 1943, these positions having been computed by Dr. H. Wichello and Mr. W. P. Henderson.

Comets move round the sun in orbits which are much more eccentric than the orbits of the planets. In other words, the comets move near the sun at one part of their orbit and then go off to a great distance—sometimes beyond the orbit of Pluto. A comet has three distinct parts. The nucleus consists of a loose conglomeration of particles—not a solid mass like a planet—and these particles vary in size. Most of them are very small, like specks of dust or sand, but some are larger and vary in weight from a few ounces up to many tons, though it is probable that the latter are very much in the minority. The coma is produced by the heat of the sun causing gases to exude from the loose matter composing the head, and is often a very conspicuous part of the comet, though it is impossible to generalise about the appearances of these objects. The tail consists of very diffuse gas and perhaps extremely fine particles of matter entangled with the gas molecules. The light pressure of the sun drives the tail away from the sun, this pressure overcoming the sun's gravitational attraction when the particles in the tail have a very small diameter. The tails of comets vary in length from a few million miles to more than a hundred million miles. Owing to the extremely diffuse nature of the gases in the tails they are quite harmless, and occasionally the earth has passed through the tail of a comet without any serious effects.

## JUNIOR SCIENCE

### Looking into Water

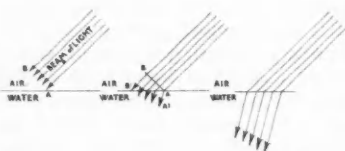


FIG. 1

I am sure many of you have been puzzled by the fact that an oar dipped in water appears to be bent at the water surface. You know very well that the oar is not really broken, but why does it appear to us as if it were? The explanation is that the light rays by the means of which we see the oar are bent when passing from water into air, and this bending is due to the fact that light has a slower speed in water than it has in air. Imagine a slanting beam of light falling through air on water as in Fig. 1. The front of the beam will first strike the surface with its

under side at the point A, while the corresponding point B, on the upper side of the beam is still well above the surface. By the time the upper side of the beam has reached the surface at B', its lower side has already travelled some distance in water to A'. Since, however, the speed of light in water is less than in air, the distance AA' must be shorter than the distance BB', which the upper side has travelled in air within the same time. The result is that now, when the whole of the beam has passed into water, its front—and with it its direction—is bent downwards. Thus an object under water



FIG. 2

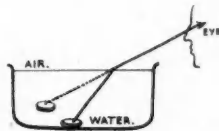


FIG. 3

appears to us *higher* than it really is, because—without our realising it—the light rays coming from it have been bent on the surface.

If you hold a knitting needle into a cup of water as in Fig. 2, that part of the needle which is immersed will appear bent upwards if you look at it at an angle. Making use of this phenomenon of "refraction", as it is called, you can even look around a corner. Place a coin into a basin as in Fig. 3 and bring your eye into such a position that the coin is just obscured by the rim of the basin. Then ask somebody to fill the basin with water and you will see the coin appear. K.M.

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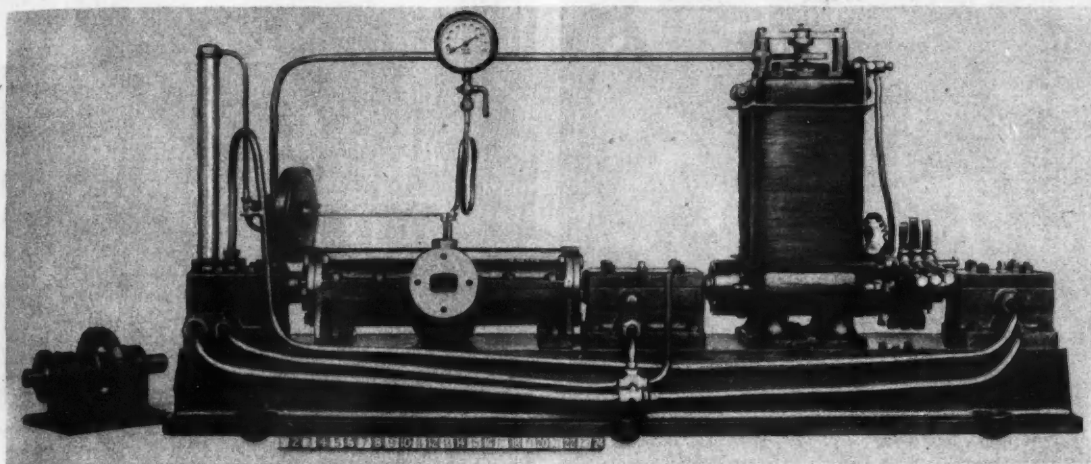


FIG. 1.—The first turbine-generator in the world, constructed 1884

## Steam Turbines on Land and Sea

R. H. PARSONS, M.I.Mech.E.

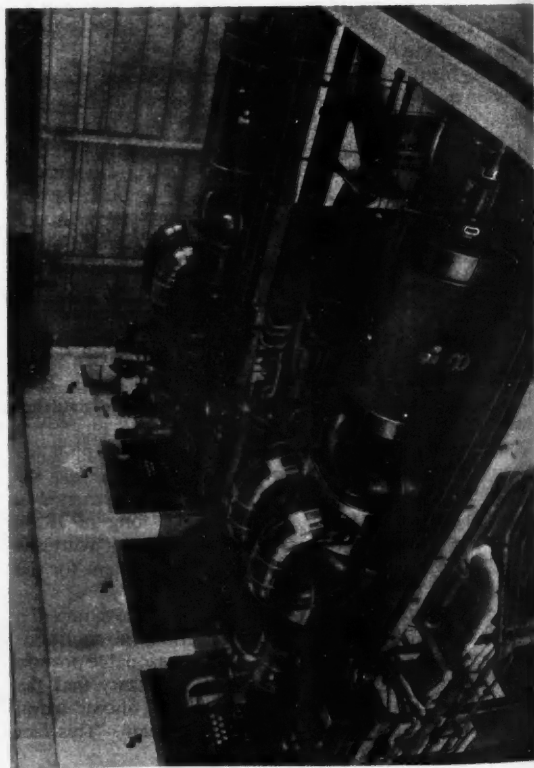
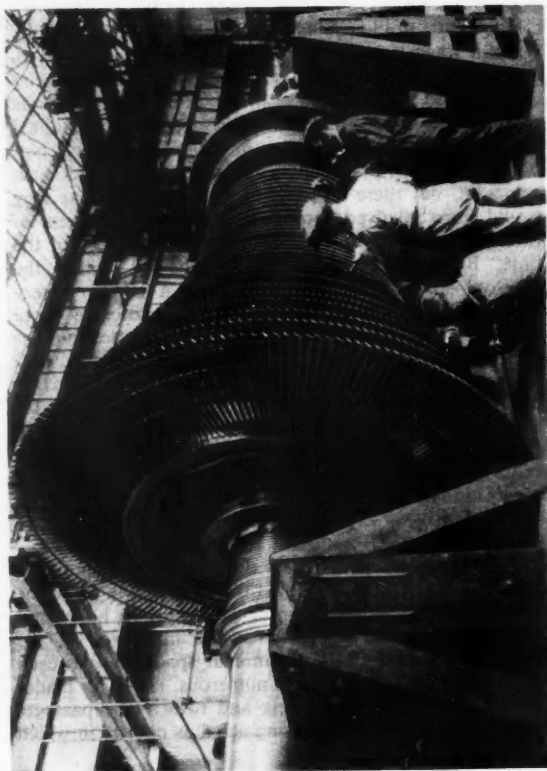
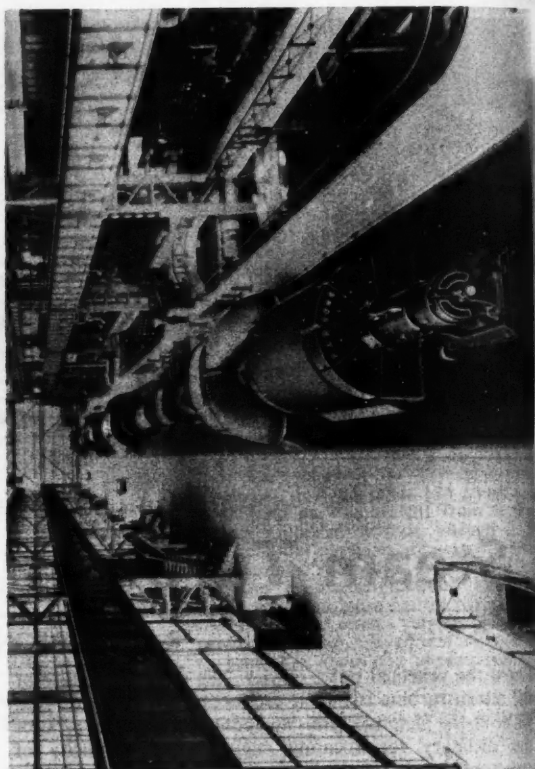
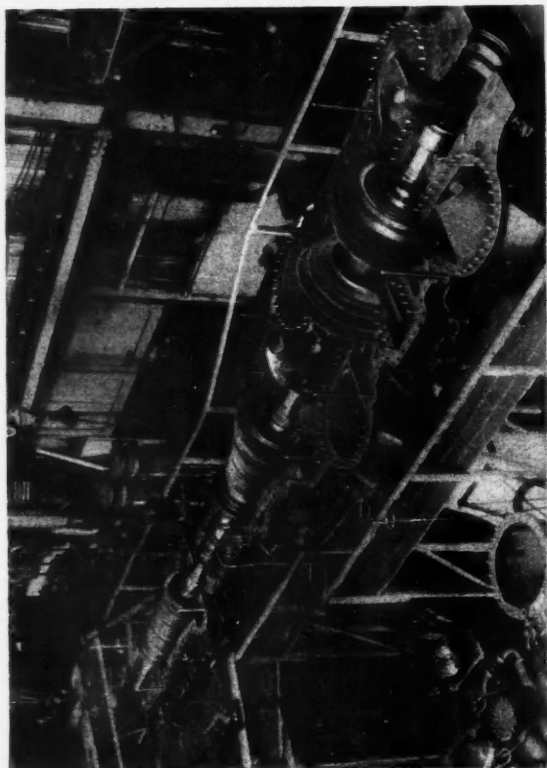
FROM the practical point of view, the essential feature of the steam turbine is that it produces pure rotary motion without the pistons, cranks and connecting rods typical of the ordinary reciprocating engine. This simplicity of structure brings with it many incidental advantages, particularly as regards the far greater power that can be developed by a single machine and the increased economy with which the steam can be used.

It is of historical interest to note that the earliest recorded attempt to use steam for the production of power was by means of a machine on the turbine principle. In a treatise of Pneumatics, dating from the second century before Christ, the philosopher Hero of Alexandria described a device consisting of a hollow sphere pivoted on its horizontal diameter. Steam was admitted through one of the pivots and escaped tangentially in opposite directions from the ends of two hollow arms, thus causing the sphere to rotate by its reaction. No effective use was made of this invention, and it was not until 1629 that a turbine of another kind was suggested by Giovanni Branca, whose idea was to make a fixed jet of steam drive a wheel by blowing against vanes fixed around the rim. This, likewise, came to nothing at the time, and nothing further was done until about the beginning of the nineteenth century, when several inventors attempted to exploit the idea originated by Hero. Notable amongst these was the great engineer Richard Trevithick, who constructed a "whirling engine" with arms 90 inches long in 1815; but by that time the reciprocating beam engine of Watt was firmly established and there was little inducement for the development of the newcomer.

The real obstacle, however, to anything in the nature of a steam turbine lay in the difficulty in utilising the enormous velocity of a jet of steam. To convert a reasonable portion of its energy into useful work it was necessary that the moving elements, whether nozzles or vanes, should travel at something like half the speed of the steam. This fact

was appreciated by Watt, who dispelled the fears of his partner Boulton as to the danger that a proposed steam turbine might prove to their engine-building business by the remark that "Without God makes it possible for things to move 1000 feet per second, it cannot do much harm."

The nature of the problem confronting inventors will be realized when it is considered that steam at only 100-lb. pressure escaping into the atmosphere develops a velocity of over 2600 feet per second, which is much the same as that of a rifle bullet, while twice this speed may be attained by high-pressure steam flowing into a good vacuum. Not only did it seem practically impossible to deal with such velocities, but there was the further deterrent that they would have involved rotational speeds far in excess of those suitable for driving the ordinary machinery of the time. But when, towards the end of the last century, the development of the dynamo opened up a field for a very fast-running prime mover, the situation became more favourable for the turbine. The late Sir Charles Parsons was then engaged in building electrical machinery, and foreseeing the advantages of a steam turbine for driving it if a practical design could be evolved, he devoted his energies to the task. His fundamental invention, which overcame the hitherto insuperable difficulty of the excessive velocity of the steam, consisted in arranging that the whole expansion should not take place at once, but should be carried out by a series of steps, each successive drop of pressure being only sufficient to generate a velocity low enough to be efficiently utilised by blades running at a moderate speed. He embodied this principle in a turbine consisting of a cylindrical rotor enclosed in a horizontal casing. Steam was admitted at the mid-point of the casing and flowed along the annular space towards each end, traversing in its path numerous rings of blades fixed alternately to the casing and rotor. The passages between the blades of each ring acted as nozzles in which



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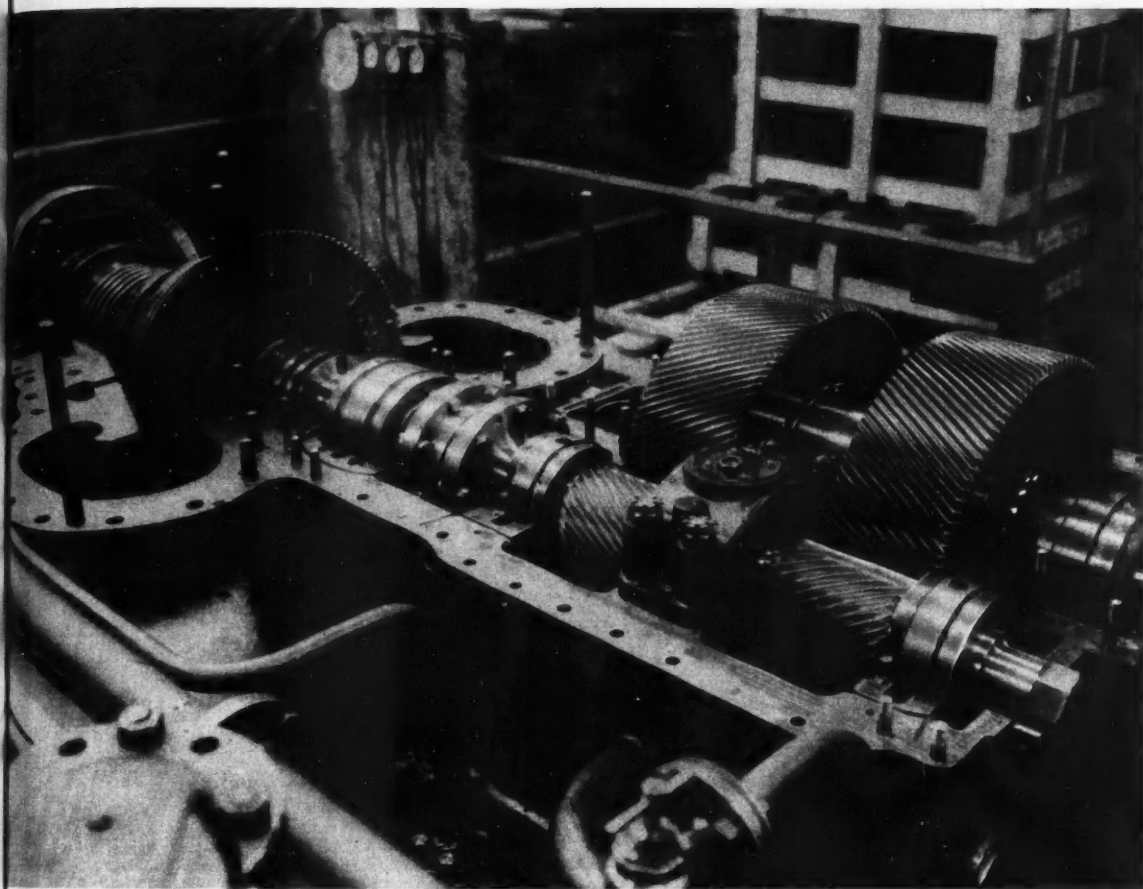


FIG. 3.—1,000 b.h.p. geared turbine with covers removed.

a small expansion of the steam could take place. The jets of steam emerging from each row of fixed blading gave up their kinetic energy to the next row of moving blades, which were thus impelled partly by the "action" of the steam entering them and partly by the "reaction" of the steam leaving them.

### Turbine Development

Parsons constructed his first turbine in 1884, a date that marks the beginning of the most momentous development in the generation of power. His pioneer unit developed about 10 h.p. and was directly coupled to a dynamo which it drove at a speed of 18,000 r.p.m. A photograph of this historic set, the first turbo-generator in the world, is reproduced in Fig. 1. The machine, which gave many years of useful service, is now preserved in the Science Museum at South Kensington. Parsons built some hundreds of similar sets during the next few years, but these were mostly employed for ship-lighting and similar duties; and it was not until 1890 that turbine machinery entered its field of central station work. In that year the Forth Banks Power Station at Newcastle started

operation with a pair of 75 k.w. turbo-alternators, and very soon afterwards sets of 100 k.w. were adopted for the new power stations at Cambridge and Scarborough. In 1894 a considerable advance was made by the construction of units of 350 k.w. capacity for the Manchester Square Power Station in London, while six years later a further big step was taken by the supply of two sets, each with a capacity of 1250 k.w., for the City of Elberfeld in Germany. Their high efficiency and excellent performance practically dispelled the last prejudice against the turbine, both on the Continent and in Great Britain, and opened the way for its general adoption for central station work. So rapid was the development that in 1912 Parsons undertook to build a turbo-alternator of no less than 25,000 k.w. capacity for the city of Chicago. This machine was by far the largest and most efficient generating unit in the world at the time, but less than a dozen years later Parsons was called upon to supply a set of 50,000 k.w. for the same city.

In Fig. 2 we show illustrations of different aspects of 50,000 k.w. sets.

Although modern turbine machinery owes both its

← FIG. 2.—Different aspects of 50,000 k.w. sets.

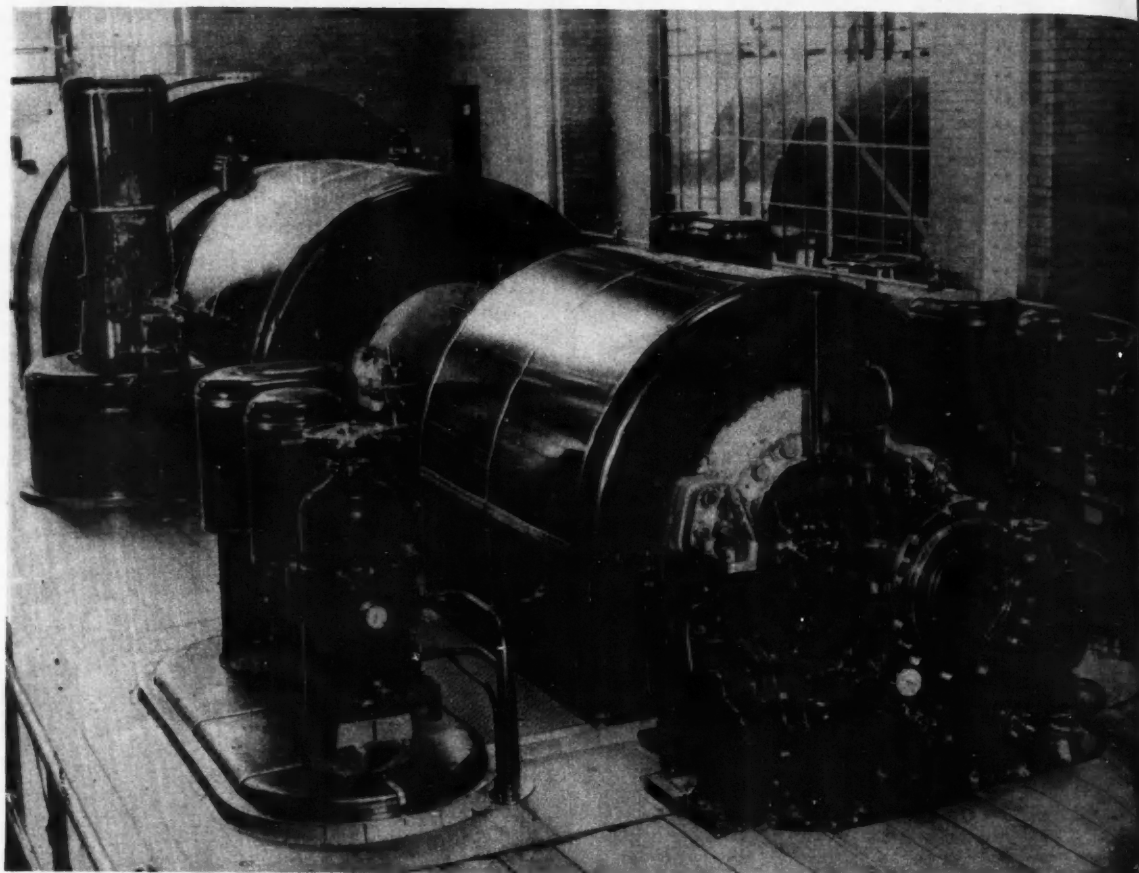


Fig. 4.—20,000 k.w. Parsons turbo-alternator, arranged for passing steam into two pressures.

origin and its establishment in industry almost entirely to the genius and energy of Parsons, it would not be fair to overlook the work of others who have contributed to its advancement. The earliest of these was the Swedish engineer, Dr. Gustaf de Laval, who devised a turbine of the kind foreshadowed by Branca, namely a single wheel with blades on its rim driven by jets of steam. To secure efficiency he had to resort to wheel speeds as high as 30,000 r.p.m., these being reduced by helical gearing incorporated in the machine. His invention of the expanding nozzle in 1889 made his turbine a commercial success, and though it was only suitable for comparatively small powers, its novel features entitle it to an honourable place in the ranks of turbine machinery.

Much more important, from the commercial point of view, was the turbine invented by the French professor Auguste Rateau in 1896. Rateau adopted the Parsons principle of expanding the steam by stages, but followed Laval by confining the expansion to fixed nozzles. His turbine consisted of a shaft carrying numerous wheels, each running in a separate compartment. Nozzles in the diaphragms separating the compartments allowed the steam to flow through the machine, the energy developed

by its partial expansion in each set of nozzles being absorbed by the following wheel.

Another inventor who left his mark on turbine design was the American, George C. Curtis. His idea was to carry out the expansion in a few stages only, and to absorb the high velocities thus generated by causing the steam from each row of nozzles to act on several rows of blades instead of on one only. After giving up some of its energy in driving the first row encountered, it was directed by fixed guide blades on to a second row, and sometimes again on to a third row of moving blades. The earliest Curtis turbines, which appeared in 1903, were built with their shafts vertical, but after a few years this arrangement was abandoned in favour of the more convenient horizontal shaft. The system of "velocity compounding" on which the Curtis turbine was based is now recognized to be relatively inefficient, though the advantages of the "Curtis" wheel are recognized by its frequent incorporation as an element of turbines of other types.

Other inventors who deserve particular credit for their work are the Swedish brothers Birger and Frederick Ljungstrom who produced a remarkably efficient and ingenious form of turbine in 1911. This embodied the

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reaction principle of Parsons, but it was carried out by causing the steam to flow radially outwards between two discs provided with horizontally projecting rings of blades. The two discs were thus impelled in opposite directions, and each drove a separate alternator mounted on its shaft.

## Industrial Turbines

The imposing size and high efficiency of the turbine equipment of modern power stations are liable to obscure the importance of the part that turbine machinery plays in other branches of industrial activity. The steam turbine was applied at a very early date to the driving of centrifugal pumps, fans and blowers, all of which are naturally suitable for direct operation by means of a high-speed prime mover. Other kinds of machinery needing to be driven at lower speeds were operated by means of reduction gearing so that the turbine could always run at the speed most conducive to its efficiency (Fig. 3). A striking example of the adaptability conferred on the turbine by the use of gearing was given in 1910 when Parsons supplied a turbine running at 2000 r.p.m. for the driving of a three-high steel rolling mill, the speed of which was only 70 r.p.m. But one of the most valuable features of the steam turbine for industrial work, particularly at the time when large reciprocating engines were common, was its ability to take advantage of a high vacuum, and therefore to generate considerable quantities of useful power from the exhaust steam of such engines. This led to the use of "mixed pressure" turbines, which normally operated with exhaust steam, but would take automatically a sufficient supply of live steam to enable them to carry their load when the exhaust steam was not forthcoming in sufficient quantity, or failed altogether.

Even more important for industrial efficiency was the invention of the "Pass-out" turbine. Machines of this kind generate the power required in a factory from steam at ordinary high pressure, and supply at the same time any desired quantity of partially expanded steam at some lower pressure for heating and process work. Since high pressure steam needs practically no more fuel for its production than low-pressure steam the power is obtained at an almost negligible cost, and the cleanliness of the steam passed out from the turbine is a valuable consideration. As an example of the importance now attained by machines of this type, a single unit of 20,000 k.w. has been supplied by Messrs. Parsons. The turbine was designed to work with steam at a pressure of 800 lb. per square inch super-heated to a temperature of 800°F. In addition to driving a 20,000 k.w. alternator, it furnished two supplies of low-pressure steam, at pressures of about 185 lb. and 7 lb. per sq. inch respectively (Fig. 4).

## The Turbine at Sea

The steam turbine was not applied to marine propulsion until its reliability and efficiency had been definitely established by some ten years' experience on land. The problems to be solved were in some respects more difficult, for while electrical machinery could be designed fairly easily for high speeds of rotation, the screw propeller was very much less accommodating. Parsons, however, had always recognized the field for the turbine at sea, and in the year 1894 he turned his attention to its development

for marine duties. He established a separate organization, now known as the Parsons Marine Steam Turbine Co., for this purpose, and proceeded at once with the construction of the *Turbinia*, a little vessel that was destined to mark the opening of a new chapter in marine engineering.

The *Turbinia* was 100 feet long with a displacement of 44 tons. After much experimental work with her propellers success was achieved, and she attained a speed of some 35 knots, which was much in excess of that of any vessel afloat at the time. She demonstrated her capabilities in a spectacular way by racing about amongst the warships of all nations assembled off Spithead for the great Naval Review of 1897 held in honour of the Diamond Jubilee of the reign of Queen Victoria (Fig. 5). Her performance created a sensation among both the naval Authorities and the public. The Admiralty could not ignore the potentialities of the new means of propulsion, and gave orders for the construction of a turbine-driven destroyer named H.M.S. *Viper*. The specification called for a speed of at least 30 knots, and Parsons and his friends were called upon to put up a deposit of no less than £100,000 to indemnify the Admiralty in case of failure to comply with the requirements. The specification, however, was handsomely exceeded, for the *Viper* actually attained a speed of over 37 knots with 12,000 h.p. developed by her turbines when officially tested over the measured mile. A second destroyer H.M.S. *Cobra* was put into commission shortly afterwards, and while the Admiralty were making up their minds about further developments, private ship-owners began to give orders for turbine-driven vessels.

The first turbine-driven passenger ship was the *King Edward*, built in 1901 for service on the river Clyde. The *Queen Alexandra* followed for the same duties, and then the cross-channel boats *Queen* and *Brighton* gave a turbine-driven service to the Continent. Meanwhile the Admiralty acquired another turbine destroyer H.M.S. *Velox*, and when in 1902 four 3000-ton cruisers were ordered, it was decided that one of them H.M.S. *Amethyst* should be equipped with turbines so that a definite comparison could be made between her performance and that of the three sister ships fitted with the usual reciprocating machinery. The result was to leave no doubt as to the superiority of turbine propulsion, and by 1905 it had been decided that all future warships of whatever kind should be fitted with turbines.

A regular transatlantic passenger service by turbine steamers was inaugurated by the 13,000-ton Allan Liners *Virginian* and *Victorian* built in 1904. Almost at once the Cunard Company followed suit with the *Carmania* of 30,000 tons, but these vessels, important as they were, were eclipsed by the 38,000 ton Cunard liners *Lusitania* and *Mauretania*, which were launched in 1906. The *Mauretania* was capable of a speed of over 26 knots with her turbines developing 70,000 h.p. She earned the "Blue Ribbon of the Atlantic" for the fastest crossing yet made, and held this honour for nearly a quarter of a century. Her sister vessel, the *Lusitania* was sunk without warning by a German submarine in 1917, with the loss of over 1000 passengers and crew—an outrage against not only international law, but also the humane conventions of the sea, which did much to bring about the intervention of the United States in the last war. The *Mauretania* continued

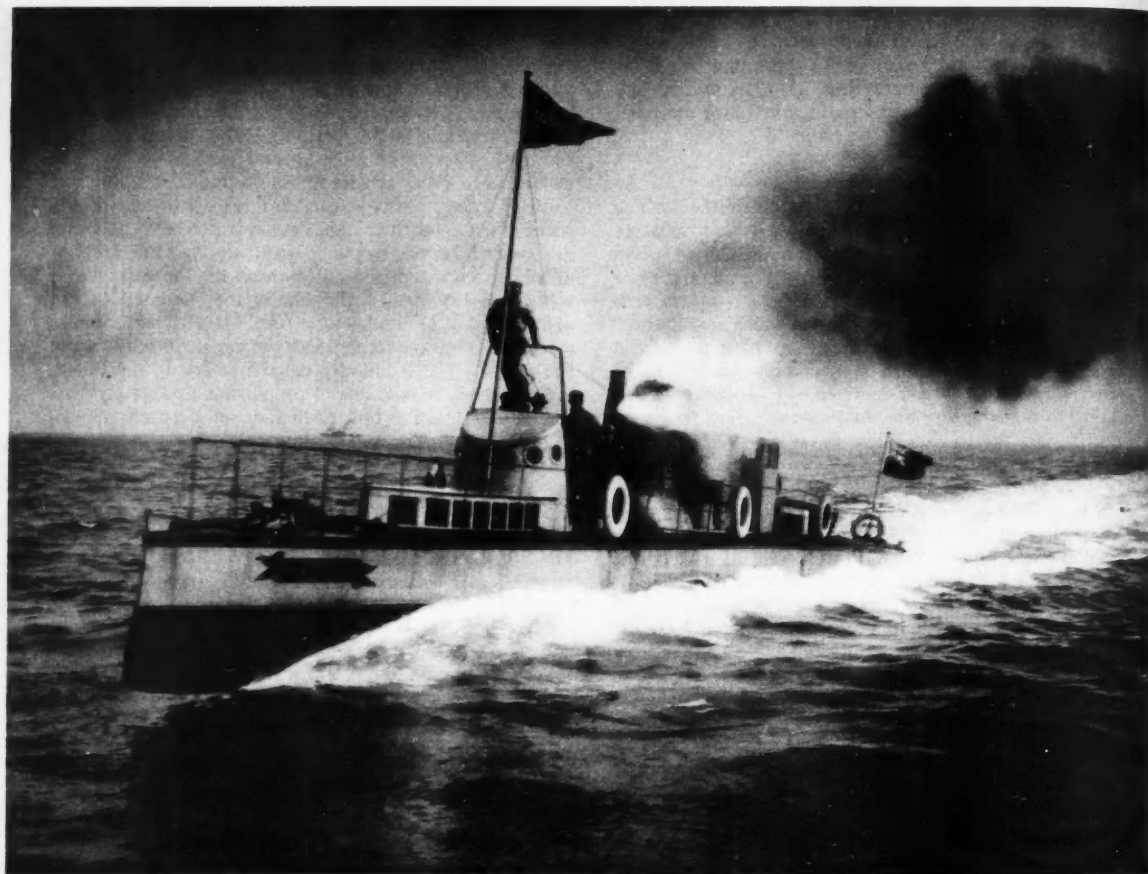


FIG. 5.—The *Turbinia* steaming at 35 knots in 1897

her honorable career until 1935, when she was withdrawn from service after a working life of 28 years. The extraordinary rapidity with which the turbine gained its ascendancy in marine work will be appreciated when it is remembered that the *Mauretania* in the Merchant Marine and the turbine-driven battleship H.M.S. *Dreadnought* in the Royal Navy were both in commission within about ten years of the first appearance of the little *Turbinia*.

From 1905 onwards there was no room for doubt in the minds of all responsible marine engineers about the supremacy of turbine machinery for fast vessels of every kind. But such vessels, important as they are, form but a small proportion of the total number of steamships. The ordinary cargo steamers carrying the freight of the world had still to rely on the reciprocating engine, for it was not commercially practicable to build turbines which would run economically at the low speeds required by the propellers. What was needed was some kind of speed-reducing gear between the turbine and the propeller so that each could run at the speed most conducive to its own efficiency. Mechanical gearing had been successfully used to reduce the speed of small turbines, but whether it

could safely be used to transmit hundreds or thousands of horse power under the arduous conditions of marine service was another matter. The question was put to the test in 1909 by Parsons, who replaced the engines of the 4350-ton cargo steamer *Vespasian* by a steam turbine arranged to drive the propeller shaft through gearing. The experiment was completely successful, and geared turbines soon became general at sea for fast as well as slow vessels because the gearing allowed smaller, lighter and more efficient high-speed turbines to be used in all classes of ships.

At the outbreak of the 1914 war, geared turbines of an aggregate of 260,000 shaft horse-power were in use in the mercantile marine, while the Admiralty had destroyers of 24,500 horse-power apiece driven by gearing. At the end of the war it was estimated that geared marine turbines with an aggregate capacity of 18,000,000 h.p. were in service or under construction, while the Navy were transmitting as much as 36,000 h.p. through a single gear wheel. Geared turbines were also employed at sea in conjunction with reciprocating engines, generating additional power from the exhaust steam of the latter, and thus increasing the propulsive efficiency of the machinery. An

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alternative to mechanical gearing is to drive the propeller shafts by electric motors supplied with current by a turbo-generator. This system has been used in a number of luxury liners, and in some American warships.

### The Future of the Steam Turbine

The steam turbine has long held an unassailable position where the production of power in large quantities is concerned, and, so far as can be foreseen there is no likelihood of its losing its present pre-eminence. Its progress in both size and efficiency during the 60 years that have elapsed since its first appearance has been enormous, but one would be unjustified in anticipating any corresponding advance in the future. Turbo-generating units of 100,000 k.w. and over are by no means uncommon in the largest power stations, and an output of over 200,000 k.w. had already been obtained from a single machine. To construct machines of greater power than those in use to-day would present little difficulty if there was any demand for such huge units, but to make any substantial increase in efficiency is well-nigh impossible.

The amount of work that can theoretically be produced from a given quantity of steam is known with the utmost exactness, and it is already so nearly attained that the margin for further improvement is small. It depends on the temperature and pressure of the steam and the vacuum that can be maintained in the condenser. Pressures of 1400 lb. per square inch have been in commercial use for many years, and there is little or nothing to be gained by going higher. Steam temperatures have already exceeded 900°F. and further advance is restricted by the durability of the super-heaters and other elements of the plant. The progress now being made in the development of heat resisting alloy steels may, however, hold out a little hope in this direction. As regards the vacuum, this is limited by the temperature of the cooling water available, and no further possibilities remain to be taken advantage of. In all these matters the law of diminishing returns comes into force, and the good designer knows that he is unjustified in proceeding beyond any point where the cost of progress becomes greater than the benefits obtainable. The steam turbine has now attained such a degree of perfection, both mechanically and thermodynamically, that it is difficult

to see how it can be substantially improved with such materials as are at present available. Small refinements of design are, of course, continually taking place, and their cumulative effect is to increase still further the present very great efficiency and reliability of turbine machinery.

It would be rash to prophesy that the steam turbine will never be superseded as a prime mover for the production of large amounts of power, but no likely competitor has yet appeared on the horizon. The success of the internal combustion engine has led, in some quarters, to a belief that some form of internal combustion turbine will be the prime mover of the future. Hundreds of such machines have been patented, and a few have been developed for actual use. The very high temperatures at which they would have to work if they were to be efficient present an obvious practical difficulty. The pressure required to operate an internal combustion turbine has to be obtained by a preliminary compression of the working mixture, or of at least of the air required for combustion, exactly as in a gas engine or a petrol motor. The work required for doing this compression forms a very considerable proportion of that developed by the turbine, so that the latter has not only to be provided with an efficient compressor, but it has to use a large part of its power in driving it. The higher the initial temperature of the working gas, the lower need be the work of compression; but if we take 1100°F. as the highest working temperature now practicable, to obtain a net output of say 1000 k.w. from an internal combustion turbine, the turbine would have to develop no less than 4000 k.w. of which 3000 k.w. would be required to drive the compressor necessary to the working of the plant. This is, of course, at present a tremendous handicap for the system. The steam turbine suffers from no corresponding disability, for the power taken in pumping water into the boiler is negligible in comparison with the output of work. The consequence is that the most successful internal combustion turbine yet built has a thermal efficiency of no more than about half that obtainable with modern steam turbine plant. Many engineers, however, are convinced that this margin can be substantially reduced, and that eventually the internal combustion turbine will be able to compete in efficiency with the steam turbine.

### From Sir Charles Darwin, F.R.S.

DIRECTOR, NATIONAL PHYSICAL LABORATORY

SIR—In your publication of October 1943, there is an article on the Electron Microscope on which I should wish to comment. This article gives an excellent description of the subject, in the course of which it enlarges at considerable length on the work of the R.C.A. I should certainly be the last to belittle this work which has brought the instrument into widespread use, but while paying a sincere tribute to it, I feel that considerably less than justice has been done to the work of others. As one example the instrument designed originally in Toronto was copied and used in a number of other places in America before it was developed for production by the R.C.A.

Again the article contains no information about work in this country. This is obviously on account of the author's ignorance of that work, since in fact some of the photographs he shows, which he attributes to the R.C.A., were taken in this Laboratory with an instrument made by Metropolitan-Vickers Electrical Co. Ltd. before ever there was any R.C.A. instrument in this country. The Metro-Vick instrument was made about 1937, and at the time was as well advanced in design as any

existing (possibly with the exception of German ones). It was at first in use at the Imperial College and was later taken over by this Laboratory. There is no doubt that but for the pressure of war work there would have been considerable developments in connection with it.

The purpose of this letter is not in any way to belittle the important contributions of the R.C.A., but merely to draw attention to the fact that there seems danger of forgetting that there have been other highly successful workers in the field.

C. G. DARWIN  
Director,  
National Physical Laboratory.

[We regret and apologize for the unfortunate ascription of Figs. 3—6 of the article "Electron Microscope" by Dr. V. E. Cosslett to the R.C.A. instead of to the National Physical Laboratory. We would however in fairness point out that this error was in no way due to Dr. Cosslett, who did not supply these particular photographs.—Editor].

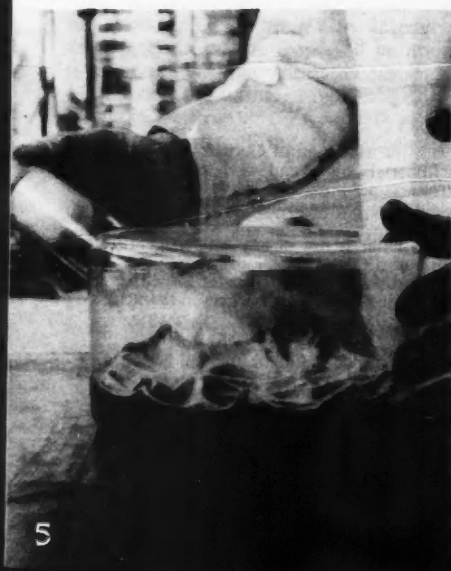
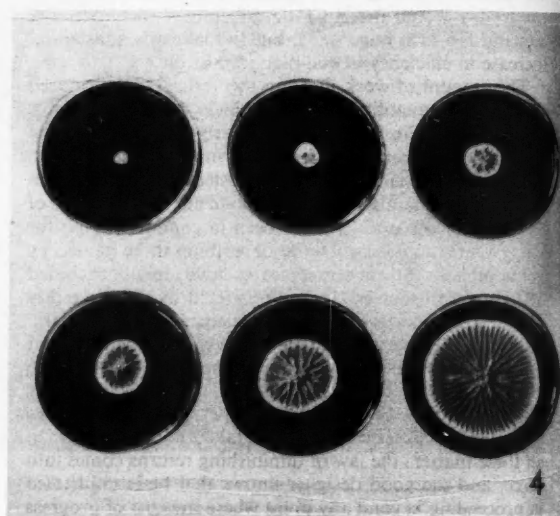
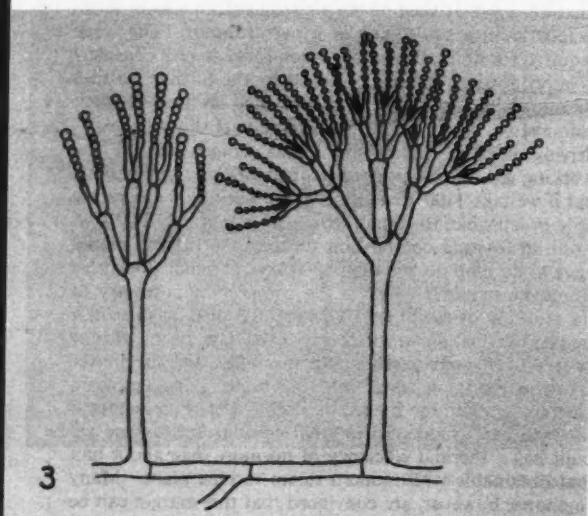


FIG. 1.—The above is a drawing of the mold which occurs on almost every sort of organic matter propagated. A branched system penetrates the air, on the tips of which are millions of spores.

FIG. 2.—Here are six colonies of *Penicillium notatum* after 10 days. The growth resembles a felt-like layer on a liquid medium, in which the culture is originally placed.

FIG. 3.—The mould can be cultivated on liquid media, but later this was replaced by a solid medium, dihydrogen phosphate, potassium chloride, and agar. The flask shows the type of flask used for large-scale production of the mould, in which the exchange between the air and the liquid is maintained.

FIG. 4.—In this rack is a sample of the output of the mould, prepared.

FIG. 5.—The concentration of penicillin was worked out by Professor H.W. Florey's original apparatus included such improvements as the principal stages in its collection depend on the exchange between the air and the liquid, which is maintained by the use of the sodium acetate, which is the exchange between the air and the liquid.

FIG. 6.—Small ampoules, each containing 100 units of penicillin, are used in medicine, contains 100 units of penicillin. It is only available to doctors of the Army.

FIG. 7.—A preparation of penicillin is being used to treat staphylococci. Other diseases which are treated by penicillin are diphtheria, gas gangrene and meningitis.



FIG. 1.—The discovery of penicillin by Professor Alexander Fleming, who is seen working in his laboratory at St. Mary's Hospital, London, dates back to 1929. Accidentally an agar culture of staphylococci (disease-causing bacteria) became infected with a blue-green mould called *Penicillium notatum*. A single mould spore developed into a colony, and Fleming noticed that around that colony no bacteria grew. The mould's antibiotic or bacteriostatic principle he called penicillin.

FIG. 2.—Professor H. W. Florey, the Oxford scientist who was so largely responsible for the development of the process used to extract Penicillin for medicinal purposes.

## Penicillin

3.—The above is a drawing of the mould penicillium. The bluish-green colour of this common mould, which occurs on almost every part of organic matter, is due to a dust of the asexual spores by which it is propagated. A branched system penetrates the substratum, and sends up reproduction branches into the air on the tips of which are small rounded spores that are freed by the faintest touch of air.

4.—Here are six colonies of *Penicillium notatum*, growing on agar-agar jelly. The smallest is one day old, the largest ten days. The mould resembles that of the related blue-green moulds that thrive on bread, cheese and rotten fruit. The culture is originally white in colour, acquiring a blue-green hue as the mould develops its spores.

5.—The mould can be cultivated on liquid media as well as on solids. In the early experiments broth was used but later this was replaced by a solution of glucose containing mineral salts—sodium nitrate, potassium hydrogen phosphate, potassium chloride, magnesium sulphate, and ferrous sulphate. The photograph shows the type of flask used in large-scale production of penicillin. The mould is seen growing as a crinkled white layer on a liquid medium, in which the penicillin accumulates.

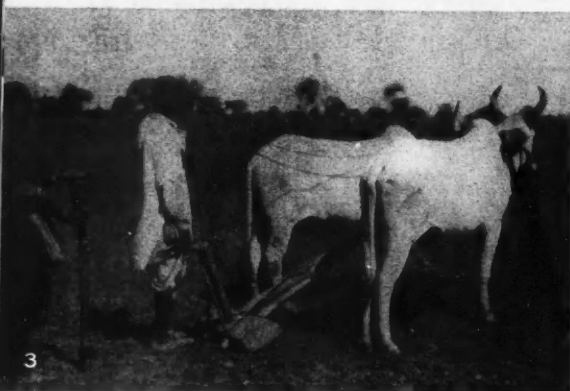
6.—In this rack is a sample of penicillin—saturated brew at a British factory where the drug is produced.

7.—The concentration of penicillin is a delicate and laborious process. The pilot plant procedure was worked out by Professor H. W. Florey's research team at Oxford at the time of the Battle of Britain, and the final apparatus included such improvised articles as a domestic bath, milk churns and a milk cooler. All the principal stages in its isolation depend on the fact that penicillin itself dissolves in organic solvents such as ether and amyl acetate, whereas the sodium, barium and other salts of penicillin are soluble in water: during an exchange between the two different types of solvent the impurities are separated out.

8.—Small ampoules, each containing a standard dose of penicillin. The final curry-coloured powder, as used in medicine, contains 10 to 20% of penicillin. This material is said to cost £100 a pound. At present it is only available to doctors of the Armed Forces, and for research purposes.

9.—A preparation of penicillin is being standardised by testing its bacteriostatic effect against cultures of staphylococci. Other disease germs which are susceptible to the drug include those causing pneumonia, typhoid, gas gangrene and meningitis.





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# Plant Breeding in India

C. D. DARLINGTON, D.Sc., F.R.S.

MAN lives on the plants his ancestors picked up on the prairie and in the jungle, plants which through many generations they selected and improved for cultivation. If all this wealth of improved plants—wheat, rice, sugar-cane and potatoes—were to disappear the greater part of mankind would perish before a year had passed.

India, in the old days, was known as the greatest store-house of plant wealth. She possessed the sugar and spices for which the whole-world hungered. It was not for the diamonds of Golconda but for the spices of Malabar that Columbus and Vasco da Gama sought the passage to the Orient.

Since those days, however, the peoples of India have multiplied. Four times as many mouths have to be fed on the products of the Indian soil. The area of land under the plough has had to be increased. Apart from irrigation this has meant the use of poorer land. The consequence has been that the staple food crops of the peasant have decreased in average yield. In the last 40 years alone the wheat land has increased 50 per cent in area. And in the same period the average yield per acre has decreased by 20 per cent (from 0.38 to 0.30 tons).

In the last 10 years this deterioration has been held up, but there has been no recovery. How urgent—indeed how disastrous—this situation is, may be seen by comparing it with what is happening elsewhere. In many other countries there has been an increase in the area under wheat. In no other country has there been such a decrease in yield. On the contrary in Britain, Sweden and Russia, owing to the application of more scientific methods, yield has been increased, and in these countries by this means alone the famine which has overtaken India has been averted.

There are many scientific methods of effecting an increase in the returns of agriculture, but there is only one which makes no demands on the purse, or the skill, or the intelligence, or indeed on anything more than the obedience, of the cultivator. It is therefore the only one which requires no change in the general system of land management. That method is plant breeding. How has it been used in the past?

## Old Method of Plant Breeding

The old way of raising crops was for each farmer to save a part of his seed for sowing next year. The farmer bred his own seed, just as he bred his own cattle; and this method is still in operation to-day in all parts of the world.

But 200 years ago (in 1727) there began to appear in Europe private firms which made it their business to raise seed for the farmer. They used better machinery for thrashing, and winnowing, and cleaning out the weed seeds. Farmers had previously sown crops of many different types of the same grain, black and white oats, and maize with grain of every colour, as indeed they still do in India.

Very often they had even sown mixtures of different grains—of wheat and rye, for example. The new seed firms were able to provide seed of one colour and quality and time of ripening. And naturally in choosing their seed they sorted out the farmers' mixtures and selected the best kind. That was important in itself. It was then a short step to the great improvements through selection that were brought about by these seedsmen. Improved grains, pulses and vegetables rapidly replaced the old ones as cultivators saw to their advantage. Pioneers like Keen and Laxton created the modern strawberry in England, and Vilmorin created the modern sugar-beet in France, raising its content of sugar from 6 to 16 per cent.

In the wake of these private enterprises, which showed the farmer the profit that he could make by growing the best seed, came a host of others glad to extract the profit for themselves without any public service—indeed sometimes quite the reverse. Names were purloined, varieties debased, and confusion multiplied. Nowadays therefore the task of production and maintenance of seed varieties has become so great, that State Institutions have had to be established first for controlling the seed trade, and secondly for practical plant breeding and for the scientific research that has to go before plant breeding. In London, Delhi, Moscow and Washington, research centres organise the production and control the breeding of new plants.

Let us see what has already been achieved in India. It is all recent history. In Mogul times the Arabs brought in their coffee while the Moguls themselves brought in the fruits of Turkestan and Persia. In the 19th century the English brought in tea, rubber and tapioca and, less successfully, *Cinchona* for quinine. And finally, in the 20th century, plant breeding at national research stations has begun to show the possibilities of improving the crops already grown, the wheat, cotton and sugar-cane. Indeed more useful work has recently been done by English plant breeders in India than in England.

## A Plan for Indian Agriculture

All the work of these research stations is, however, only a beginning. The tropics are a vast and still largely unknown treasure-house. From all their regions Indian agriculture can and must be re-stocked. Collections of the main economic plants suitable for India need to be assembled and tested. These should not be confined merely to the species of the systematic botanist, but should also include the local varieties of the farmer. In India, as in England, botanic gardens need to develop their function as places of acclimatisation for new species and new varieties of useful living plants, oil palms, citrus fruits, bananas, fibre plants and timber trees which can be sorted out by trial and experiment. New stations need to be

FIGS. 1, 2—Primitive methods, both laborious and inefficient, of threshing (left) and winnowing (right) wheat in N.W. India. 3, 4—Old and new methods of cultivating cotton on the same piece of land in Bombay Province: sowing cotton seed (left) and harrowing (right). 5, 6—Tea plantation in Travancore showing scientific and standardised management (left) and tea factory in same plantation (right). 7, 8—Peasants taking their bullock waggons loaded with sugar-cane to a factory in Dampur State (left) and cross-pollinating cotton at an Indian agricultural research station (right). Note that the technical assistant has an assistant.

(Photographs reproduced by kind permission of the High Commissioner for India)

established for dealing with special crops which can be most speedily turned to advantage either for home food production or for export.

After the first sorting out, the next task is to produce new plants by hybridisation, to be followed by a second sorting out. The greatest possibilities of advantage at this stage are with the luxury crops, or more properly the vitamin crops, so sorely lacking in India. Owing to the increasing poverty and the relative backwardness of communications and marketing in India, the area of land under these crops has steadily declined in the last 30 years. Fruit and vegetables have gone down from 5·7 to 4·8 million acres; and oil seeds similarly have made room for wheat. Meanwhile fruit is imported. How different it might be! Indian fruits alone could, by suitable breeding and cultivation, become a vast source of export revenue. This would be so even if we had at our disposal only the old methods of 100 years ago. But now it is a very different matter. To-day we can re-shape the heredity of plants—and animals—by drugs and X-rays, making them larger or smaller, quicker or slower growing, annual or perennial. By chemical devices we can cross species hitherto uncrossable and, having crossed them, we can by further devices make the sterile hybrids fertile again. And, under the microscope, we can tell how these changes take place as well as how the great advances of the past were made. Indeed the opportunities awaiting those who are willing and able to exploit scientific methods of plant breeding in India and elsewhere are beyond calculation.

There are great areas of jungle and desert in India which are uncultivated because no one has yet found a crop suitable for them. In order to utilise these vast expanses of waste land, it is our business, if we cannot find a suitable crop ready to hand, to make a new one. And if millions of Indians suffer from malaria it is not enough to say that *Cinchona* will not flourish in India. New types must be found, and new hybrids raised, which will flourish. Great areas of Russia, Sweden and Canada, have been brought under cultivation by making new plants to suit them. New frost-resistant apples, new hardy rye-wheat hybrids, new drought-resistant or sand-binding grasses, new forest trees have been bred for that purpose. What has been done for the arctic desert can also be done for the tropical desert.

### The Administrative Background

There are, however, several other innovations needed before the people of India can profit by these discoveries. The first is that men must be trained to handle plants in quite a different way from that established in the Universities of England and India. It is impossible to meet the needs of agriculture in India merely by taking new scientific methods out of a book. The technique of scientific plant breeding requires creation and initiative instead of the old gifts of description and repetition which are favoured by examinations even more, if possible, in India than in England. Progress in research will therefore demand the breakdown of the caste barrier between hand and head work in India.

A knowledge of the plant and its cultivation alone is not always enough. The use of fibre, food and drug plants needs special study by industrial experts who are working with the plant breeders. This kind of collaboration has been brought to perfection in various countries in the

breeding of wheat, flax, cotton and sugar-beet. It will have to be extended to other crops.

The most important condition of all is that the new plants shall be brought to the cultivator. In countries where scientific farming is taught in schools and colleges, private enterprise has sometimes been found sufficient to take new plants to the farmers. In the United States hybrid maize seed was introduced for cultivation in 1933, and already by 1939 (so quickly did the news spread) some 20 million acres of hybrid maize had come to be grown annually. In Soviet Russia, on the other hand, the State Agricultural Organisation, which employs a staff of over 20,000 workers, controls all plant breeding. It can ensure the immediate and universal cultivation of any new improvement as it becomes available. This method seems to have been suited to the conditions of a country where the application of scientific methods was new to the cultivator. Again, in Sweden a mixture of the two methods is highly effective, but new state-controlled plant-breeding stations for forest trees, fruit, flax and other crops are gradually and profitably covering a wider field.

Indian experience in these matters is instructive. A new variety of sugar-cane is propagated by cuttings and can be readily distributed. In consequence four-fifths of India's sugar-cane fields are now stocked with improved varieties and in 40 years the average yield per acre for the whole country has risen from 0·9 tons to 1·35 tons. Again, when we turn to crops like tea, coffee and rubber which are produced by scientifically managed companies, we find a regular increase in yield in recent years. But when we come to wheat which is grown from seed raised by each peasant, and largely for himself, we find that only one-fifth of India's wheat acreage is sown with improved varieties. And the yield per acre, as we saw earlier, has declined.

The lesson of these contrasts is quite simple. In India, government agencies must distribute seed of improved varieties to the peasant. Otherwise the work of the plant-breeder in the research stations is simply being wasted.

The facilities of communication and marketing for the disposal of new and increased crops must also be improved; for, as was found here and in the United States of America before 1939, it is impossible to develop an improved system of agriculture so long as the fruits of the soil have no purchaser. A government which is paying one lot of people not to raise pigs or potatoes cannot be expected to pay another lot of people to breed bigger and better pigs and potatoes. A government must clearly decide which policy it intends to pursue before it begins with either.

Summing up, we can see that to take full advantage of scientific methods in plant breeding—as in every other field of applied science—we must take long views. We must explore and survey the whole world and we must be prepared to look forward 20, 50 or 100 years. A country as large as India can afford to take these views. Such a policy will be painful, for it will mean throwing over those traditional beliefs of government and people which in India, as in England, stand in the way of applying science to the common good. On the other hand, it is certain that, without taking bold steps in new paths, India can never feed herself properly again. Still less can she be expected to play any useful part in the Food-Fellowship of the United Nations for which we have now to prepare.

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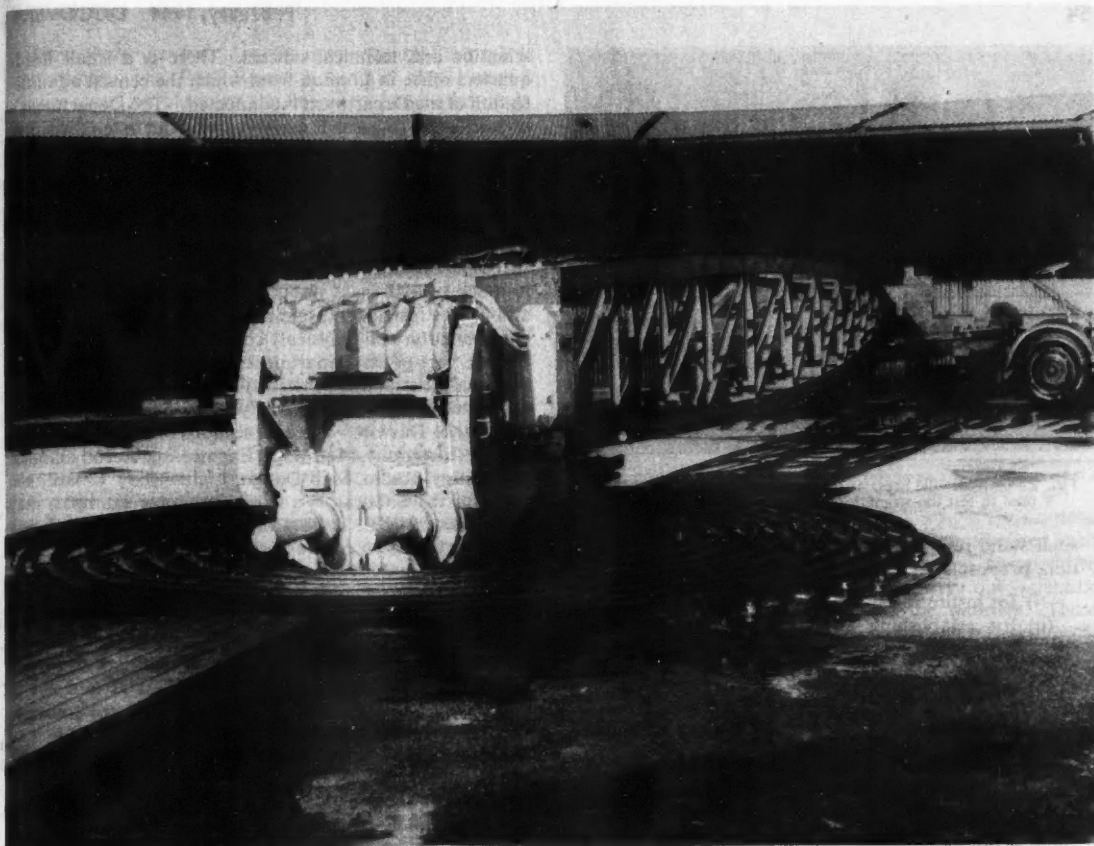


FIG. 1.—Machine at the Road Research Laboratory, Harmondsworth, on which tyres and road surfaces are tested.

## Department of Scientific and Industrial Research

ITS FUNCTIONS AND MACHINERY

SIR EDWARD APPLETON, K.C.B., LL.D., F.R.S.

SECRETARY TO THE DEPARTMENT

SINCE the time of the Renaissance, man has been systematically studying his surroundings and himself, a study which we now call science. This has yielded, at an ever-increasing rate, a body of knowledge which is not only illuminating to the mind, but has been proving itself of more and more practical use when applied to the industries and occupations on which modern life is so dependent. The new industries and the new developments of old industries which sprang into being when the usefulness of this knowledge was realised, revolutionised our manufacturing technique. But such a situation cannot be static. The continual discovery of new knowledge means a continual development of industry, and it came to be realised that it was the duty of the State to ensure that this new knowledge should be used by industry in the interests of national prosperity. At the same time it was realised that there was also a wide field of scientific inquiry relating

to human needs which it was the Government's duty to pursue on behalf of its own nationals.

So, in July 1915, His Majesty the King in Council ordered that there should be a Committee of the Privy Council, presided over by the Lord President of the Council, to direct the application of money voted by Parliament for the organisation and development of scientific and industrial research: and to carry out this task the Department of Scientific and Industrial Research was created. In order that the best knowledge and experience of science and industry should be available to guide this new venture of Government, a Council was set up to advise the Lord President on the conduct of this work. Let me quote from the Order-in-Council:

"Moreover, it is further ordered that, for the purposes aforesaid, there shall be an Advisory Council to which

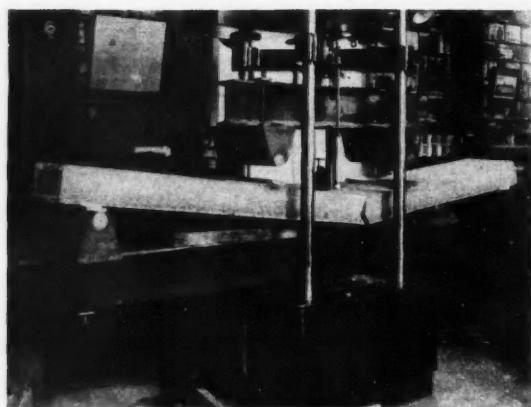


FIG. 2—A hydraulic press at the Building Research Station is used to test the strength of a hollow concrete beam.

shall stand referred, for their report and recommendation, proposals:—

- (i) for instituting specific researches;
- (ii) for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades; and
- (iii) for the establishment and award of Research Studentships and Fellowships.

The said Council may itself initiate such proposals and may advise the Committee on such matters, whether general or particular, relating to the advancement of trade and industry by means of scientific research as the Committee from time to time determine."

Those who drew up this Order planned the part which the new Department would have to play in the years to follow. While leaving freedom for development as conditions changed, they yet gave clear indication of the directions in which Government participation in scientific work would be most profitable to the nation. The experience of the last 29 years has shown that their clear vision provided the nation with a powerful instrument for good.

We stand now in a very similar position to that in which the nation stood in 1918; we are looking with hope to the days when peace will come and there will be a chance to rebuild again, making use of all the latest discoveries of science. This is therefore a time when it is profitable to review the achievement of the past 29 years and to consider whether any changes in policy or organisation are shown to be desirable in the light of that experience, and the conditions which now exist and can be foreseen.

### Organisation and Scope of the D.S.I.R.

I can here only give a brief outline of the organisation and scope of the Department of Scientific and Industrial Research. It is a department of Government, deriving its funds from the Exchequer on the Vote of Parliament. The Lord President of the Council is the Minister of the Crown responsible to Parliament for its activities. It has a staff, at present something over 2,000, consisting mostly of

scientific and technical officers. There is a small headquarters office in London from which the central administration of the Department is conducted. The Department's own scientific research is mainly carried out in ten divisions, some of which are themselves composed of a number of units. The work of each of these would merit a separate article, but a brief mention of them will indicate the wide scope of the Department's activities.

The largest of the Department's laboratories is the National Physical Laboratory at Teddington, which was founded in 1901 as a public institution for standardising and testing instruments and materials and for the accurate determination of physical constants. The Laboratory became part of the Department in 1918, though the supervision of the scientific work is still exercised by a Committee appointed by the Royal Society. The present Director is Sir Charles Darwin. The nine sections of the laboratory—Physics, Electricity, Metrology, Engineering, Aerodynamics, Metallurgy, Radio, Ship Design, Light—show broadly the scope of the Laboratory's work, but some examples may be of interest. The Laboratory gives advice on the design of concert halls to ensure good acoustic properties and it has advised, in this way, on the improvement of the Houses of Parliament and the Albert Hall; while another section has carried out important fundamental studies of fatigue in metals. Some of the huge transformers of the electricity grid can be tested at voltages up to a million volts, while another section is responsible for the test as a result of which you will probably find that your doctor's clinical thermometer has the monogram *NE* engraved on it to show that its accuracy has been tested at the National Physical Laboratory.

Also at Teddington is the Chemical Research Laboratory which carries out chemical work for all sections of the Department as well as pursuing special problems, such as the study of synthetic resins and tars. You may have heard of the new food yeast, high in protein and vitamin B, which has been developed there.

Near Watford there are two laboratories, the larger of which is investigating building materials and methods of building construction. As you can imagine its work is of special importance at present in the plans being made for building after the war. The other laboratory concentrates on methods of treatment of sewage and river water.

At Princes Risborough is the Forest Products Research Laboratory which studies the seasoning and preservation of timber and its strength and structure. This work is leading to much valuable knowledge on the economical use of timber.

Near Slough are two more laboratories, though with very different objectives. One studies methods of road construction, while the other has recently embarked on the investigation of the problems of combating infestation of grain and other produce by insects and similar pests. There are three laboratories working on the problems of processing and transport of foodstuffs; one, the Low Temperature Research Station, is run in co-operation with Cambridge University; another, the Ditton Laboratory in Kent, studies the preservation of fruit, while that at Torry near Aberdeen is concerned with fish. One of the most significant achievements of this part of the Department has been the study of the dehydration of foodstuffs, a development of special importance in war time.

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Then there are two organisations of great economic importance. The Fuel Research Station at Greenwich studies many problems on the use of coal and other fuels. No doubt you have seen behind buses and cars the producer-gas trailers which the Fuel Research Station and industry together developed to help to reduce the demand for petrol. By combining the results of laboratory studies with information gained from the systematic physical and chemical examination of all the coals in the country, this organisation is in a position to advise on the most suitable kind of coal required for any particular purpose. Now that all the ungotten coal of the country belongs to the nation, the Coal Commission and this Coal Survey are working together to ensure that these coal resources are used in the best possible way. In this work, as in other problems, there is close collaboration with the Geological Survey. This is the oldest of the component parts of the Department, having been founded over 100 years ago. It has been engaged on the discovery of geological information of increasing accuracy and economic importance, which is recorded on large-scale maps and in published memoirs and is displayed in the Museum of Practical Geology in South Kensington.

At the head of the staff of each of these laboratories is a Director who is chosen both for his special knowledge or experience of the particular work of the laboratory and for his ability as a leader of a team. But in his direction of the research work of his laboratory each Director has the benefit of a Board of experts in the field of the laboratory's work. These advisory Boards and Committees of the Department consist of eminent scientists and industrialists who, at the request of the Lord President, give a great deal of enthusiastic help to the Department in its work. The success of the work and the esteem in which it is held is due in large measure to the advice and assistance which the members of these bodies have freely given.

The scope of the Department's work may be roughly described as embracing all branches of natural science with the exception of agriculture, medicine, fisheries and forestry. There are two other Councils charged with research into Agriculture and Medicine, with which the Department works in close co-operation. The responsibility for studying the application of science to warfare rests with the Service Departments, which have their own research establishments with which also the Department has always worked in close collaboration. But there are many ways in which the laboratories of the Department of Scientific and Industrial Research, though designed and staffed for the pursuit of peaceable aims, have been able to direct their efforts to solving problems of war.

The scientific work of the Department itself can be summed up as research which is required for Government, or undertaken in the national interest for the general benefit of the community, on problems affecting the everyday life of the citizen, together with special testing work and other investigations for industry, carried out at the cost of the applicant.

### Encouraging Industrial Research

But one of the chief reasons for the creation of this Department of Government was to encourage industry to undertake research. The scheme devised for this purpose was a venture in co-operation both within industry and

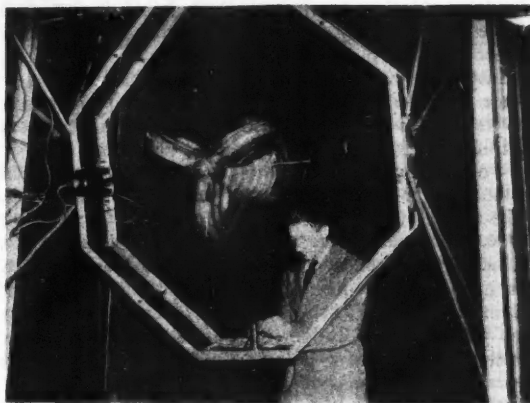


FIG. 3.—A wind tunnel in the Aerodynamics Department of the National Physical Laboratory in which models of aircraft are tested.

between industry and Government which has proved itself sound. Individual industries have formed co-operative associations with laboratories to carry out scientific research on problems common to the industry. These research associations derive their funds partly from contributions made by the member firms of the industry. But to encourage the formation of such research associations, the Department offered to pay grants towards the cost of their work, based on the amount contributed by the industry itself. It was soon found that there was a minimum size for such an association to be of any practical use. So the grants are offered in a double form: provided the industry subscribes a minimum of, say, £10,000 a year, the Department matches this with an amount, depending upon the circumstances of the industry. Then for every £100 above that £10,000 the Department would be prepared to pay another £100 (or appropriate sum) up to some maximum additional grant. This provides an extremely flexible method which can be varied as thought fit after the circumstances of the industry have been carefully examined and discussed with its representatives. To meet this expenditure, Parliament first voted a fund of £1,000,000, which, it was hoped, would enable research associations to be set up and become independent. But this hope was not realised before the fund was exhausted, and it was found necessary to continue grants from the annual vote of the Department.

Provided that these associations are organised on a model scheme drawn up by the Department on the basis of its experience, the Advisory Council of the Department requires only one major condition, and that is that the Association shall duly prosecute research for the benefit of its industry—a condition which is interpreted in the broadest possible way.

So the research association stands as a body which is helped by Government to serve industry scientifically. The Department gives financial support and is always ready to give advice to an association in its work. The Association is, in its turn, in contact with the industry, studying its problems and interpreting them in scientific terms. It carries out in its laboratories a programme of research, decided upon by the industry itself, on the

fundamental scientific principles which govern the industrial processes. It is by studying these that the Research Association can play such an important part in helping its industry. What may seem to the factory manager to be quite unrelated troubles in the production process may be recognised by the industrial scientist as different manifestations of the same underlying principle.

Up to date, some 25 research associations have been established and more are being formed now. The aggregate expenditure by these associations is of the order of £750,000 a year. Once more, I should like to describe some of the excellent work of absorbing interest which these bodies have done and to tell of the part many of them have played in solving the problems produced by the war. While I cannot do this here, I think it is of interest to note those industries which have established research associations, viz:

Automobile	Iron and Steel
Boots and Shoes	Launderers
Cast Iron	Leather
Coke	Linen
Coal Utilisation	Non-Ferrous Metals
Cocoa	Paint
Cotton (with Rayon and Silk)	Pottery
Electrical	Printing and Packaging
Flour Millers	Refractories
Food	Rubber
Gas	Scientific Instruments
Internal Combustion Engines	Shale Oil
	Wool

Choosing at random, I will mention two examples of work done by these Associations. The problem, in manufacturing glazed earthenware, called "spit out", has been examined by the Pottery Research Association. A scientific theory as to its cause was evolved and tested in practical trials by manufacturers. These trials showed that the theory was sound and it has gone far to eliminate this trouble. The Electrical Research Association has given a great deal of attention to the study of surge phenomena in electric power lines, including the effects of lightning. The results of this have contributed materially to the safety and reliability of electric power supply systems.

It should, of course, be remembered that there are some industries, notably the chemical, photographic and electrical industries, which have large and flourishing private research laboratories maintained by individual firms. This is all to the good, for not only can the Research Association serve an industry in the study of fundamental problems common to all the member firms, but it can do much to create in the industry an atmosphere of understanding of the scientific method, thus encouraging firms to establish their own laboratories to deal with the many problems which can best be solved on the spot, and to pursue new lines of development.

## Grants

The third broad division of the Department's function is the award of grants to students and research workers. These are of three kinds: maintenance allowances to supplement the student's own funds or scholarships at the University; senior Research Awards which are made with the support of a professor's recommendation to enable a promising graduate to carry on research after taking his degree; and grants for work of special timeliness and promise. About these awards from the Department I will only say that there must be many research workers to-day who have benefited from them and recall with gratitude the help they have received from the "D.S.I.R."; and that the Committee of the Advisory Council which examines all the applications for these grants has always refused to allow the number of grants to be increased simply by lowering the standard of attainment which they believe is necessary in the recipient if he is to benefit from his work at the University.

This, then, is a brief review of the work of the Department of Scientific and Industrial Research, and there are two broad conclusions which can be drawn from a study of its work during its lifetime. The first is that it is not enough that scientific work should be done by research associations, Government Laboratories or industrial organisations, unless active steps are taken to turn the results which come from the laboratory into a form which can be understood and assimilated by the factories themselves. We must learn the lesson of developing research work and applying the results. For this, there must be real understanding and interchange of ideas between the scientist in his laboratory and the industrialist in the factory. Scientists must go into industry to study problems on the spot and in industry itself there must be men who understand the scientific outlook.

My second conclusion is prompted by the present fashion of setting out statistics to show that we in Great Britain only spend some small fraction of the money on research which is spent by U.S.A. or U.S.S.R., and that we have fallen to fourth or fifth place in the world in our science. From what I have seen of the work of our scientists during the war, I can say without reserve that our scientific work is second to none. But on the question of expenditure, even if we make allowance for the vague definition of the word "research" which is so often used to include what I should call "development work", I am still not greatly moved by these comparisons. I ask, instead two questions: first, is the money we spend on research spent wisely? To that I think we can answer "Yes", for we have good scientific teams led by men of the highest quality; and second: are we spending as much as we ought to spend? And to that I would answer "No". But in the years which are to come, after peace is declared, British Industry, the Universities and Government working together will I hope lead the world in scientific and industrial research.

## Plastic Printing Plates

An inquiry instituted by *World's Press News* into the use by American newspapers of plastic printing plates revealed that 30% of the users have found plastic plates satisfactory. Some 60% of the users found such difficulties as careful handling needed due to their brittle nature: very fine serifs on types are rounded over

and lost after several mouldings; they dull saws and router bits; they may not stand heat under direct pressure. Only one instance was reported of the plate itself proving defective. In this case it developed pin holes on the printing surface after moulding. Some newspapers claimed a sharper reproduction and a cleaner print.

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# Rural Reconstruction

C. S. ORWIN, M.A., D.Litt.

EVERYONE is talking about post-war reconstruction, and agriculture and country life are having their full share of the limelight. When I listen to what is said or read what is written about it all, I often feel that we are not giving enough consideration to the fundamental things—the foundations upon which reconstruction will have to stand.

In the first place, it is quite evident that to a lot of people, reconstruction means nothing more than the preservation of things as they are. For the most part, rural England is pleasing to the eye, and many people would be content to prevent things being done to disturb it. They want to control the location of industry, for example, and some people want to keep it out of the countryside altogether. They want to restrict the use of land for non-agricultural purposes. The extremists, if I read them aright, would like to stop the further application of machinery in farming and rural industries, and would like to get back to a kind of Mid-Victorian self-sufficiency on each farm and in every village.

All this sort of thing seems to me to be taking a very negative view of reconstruction. No doubt there are many things that we want to stop people doing, if we are to have the countryside we want, but we are never going to get very far merely by stopping people doing things. To say that factories must not come into the country, that land which is devoted to agriculture to-day must never be diverted from it, that science and invention must not be applied to farming, that nothing must be done to change the characteristic features of our villages, is to suggest that we have reached perfection and that further progress is impossible.

This seems to me to be a fundamental misconception of what planning and reconstruction should be. The countryside as we have got it represents a never-ending evolution from one generation to the next, each one making its contribution, and any attempt to stereotype things as they are to-day is contrary to the whole spirit of progress and reconstruction.

Or look at the question not from the point of view of the land and the villages, but from the point of view of the people who occupy them. What is the rural population that we ought to have, and what sort of a life should agriculture and rural industries be expected to give it? We hear a lot said about getting a better balance between town and country, and about bringing people back to the land. In various ways it is suggested that we want to have more people working on the land.

## Fundamental Question

Here, anyhow, is a more positive policy, but have the advocates of putting more people on the land ever considered, I wonder, how it is to be managed? You can get more people making motor cars by building another factory, but land is limited and there is no room for expansion in British agriculture. People *must* leave the land. The fundamental question, in connexion with rural reconstruction is therefore—Are we to have two men

employed by traditional methods to do the work which one man can do with a modern machine? The grinding poverty of many peasant countries in Central Europe, in India and elsewhere, is due mainly to the lack of employment alternative to agriculture. Their people must stop on the land, and the land does not expand as their populations grow. Our rural population has been lucky in being able to leave the land.

Or take another fundamental question—the question of the right of the individual to do what he likes with his own. Right up to the outbreak of the present war, the right of the owner to withhold land from the use of the community was freely exercised and hardly challenged. But it is fundamental to post-war planning that both ownership and occupation of land should be subject to a pretty rigid control in the interests of the whole community, and we have got to make up our minds how we are going to do it.

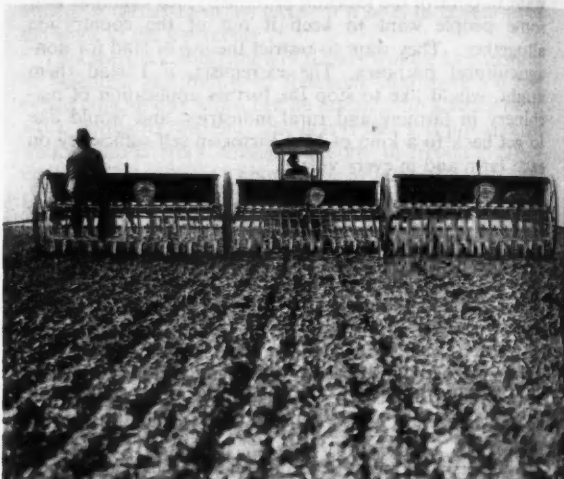
These are some of the questions that we have got to be clear about before we can begin to reconstruct, and of course there are more. My own idea is that the basic aim should be to give a better life, both material and spiritual, to those who live by the land. How can we improve their economic position, and give them the services and the amenities which are conspicuously absent from their lives at present—water, electricity, drainage, transport, etc.? I think we can get a lot of help from history in clearing our minds on what we want and how to get it. All the talk to-day is concerned with the need for maintaining a prosperous agriculture. It is assumed that if farming can be made to pay, everything else will follow. I doubt if this is sufficient. Country life in the olden days was made up of much more than farming. It included also almost every sort of industries. Even in my day, any considerable village would have its blacksmith, its miller, wheelwright and saddler. Many of them would have also a maltster, tanner, roper and so on. Many of them, too, would have a tailor who made clothes and a bootmaker who made boots and shoes, real tradesmen. In the last two generations, nearly all have disappeared. Factory-produced farm and domestic requisites and clothing have killed the village tradesmen, and with their disappearance the whole character of village life has changed.

I think most of them have gone for good, and if a mixed society, agricultural and industrial, is the ideal, as I think it is, then planning for reconstruction must encourage, not discourage, the migration of light industries into country districts.

## Factories and Rural Areas

I expect most people know places where manufacturing industries are established in the smaller country towns and larger villages to the great advantage of both. It may be an old industry arising originally from the local agriculture, like the blanket factories at Witney, and the beech furniture at High Wycombe, and more recently Beet Sugar Factories. It may have nothing to do with existing local production, as the M.G. motor works at Abingdon. It

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may be nothing more than a brewery. Any combination, however, of agricultural and industrial life makes a healthier society and gives more opportunities. Re-planning might take account of what could be done to create new industries, canning, cheese, etc.

However much farming and farmers may benefit by the development of more local industrial markets, however much the provision of amenities and public services would be facilitated by the presence of the industrial population, we have still got to remember that agriculture is the business with which most country dwellers are concerned, and any re-planning of the countryside has got to consider the kind of life which agriculture afford its workers on the purely material side. We have not finished planning when we have given piped water supplies and bathrooms, and when we have wired country cottages for electric light and power, on when we have improved the transport services and the opportunities for recreation and amusement. The rural worker has got to live, and he wants a standard of living as good as other people's. It is no good to say, as some people do, that this is mere materialism and we must think more of cultural values. We are a very long way from the point at which the mass of the workers are being corrupted by prosperity.

I think that here we have got up against one of the most difficult problems. You may say, if you like, that it is for the nation to see that the farmer's market is good enough to enable him to pay comparable wages, but you have got then to be prepared to answer the question, "Is the organisation of farming comparable with that of higher wage industries? Does it afford the opportunities that they afford?"

### Units of Organisation

This brings me to a problem of rural reconstruction which I believe lies at the root of the matter. Are our farms and fields themselves designed to facilitate the greatest production by the most economic means? As I said before, agriculture cannot be an expanding industry and the only way by which to pay higher wages is by increasing the value of the output of the labour employed. You can do this by subsidies, as we are doing now, or you can do it by increasing the mechanical equipment of the farm. A man can milk ten cows by hand. A man and a boy can milk thirty cows with a milking machine. A man and a boy can milk sixty cows with a Hosier bail. Other things being equal, the man on the Hosier bail is worth about four times as much as the hand milker, and about twice as much as the man on the milking machine. But this sort of labour organisation is impossible on many farms because of their size and layout.

Our farms and fields were laid out, most of them, more than a hundred years ago for a different sort of farming, before science and invention had revolutionised the processes of food-production. The ancient units of organisation with which we are still working, offer no scope for management and no advancement to labour.

Before we can expect the State to put its hand deep in its pocket to assist rural industry and rural workers we have got to make a careful survey of all the circumstances of country life to-day and be prepared with a reconstruction scheme as big as anything which is likely to be proposed for industrial reconstruction. We have got to advance a long way, I think, from the position which many



people seem to take, namely that there is not much to be done by the countryman himself. As I implied at the beginning, I find too many people who are inclined to be complacent about farms and farming, about rural housing and public services, about the worker's wages and the amenities of his life. Their view is that they can do little, that indeed little reconstruction is needed, and that all difficulties will be met by controlling the townsman when he ventures into the countryside, either for business or pleasure, and by subsidizing agricultural prices. I, on the contrary, suggest that there is a great piece of work to be done before we can begin to feel that we have exhausted the possibilities of reconstruction. I think the time has come for the organisation of a great national survey of the countryside to find out what it needs, to give the people more both of the material and the spiritual values of life.

We have got to have control of development. We have got to be able to stop people doing things to destroy the amenities of the countryside. But we must be very careful in so doing to remember that there are a vast number



of people who are not countrymen but who have a right to share the country with us. We must remember that there are very many people who are countrymen who find life often a pretty dull business and, not infrequently, a pretty grim struggle. We have got to let the townsman have the access he wants to the countryside; he must have his motoring roads, his refreshment houses, his opportunity to walk and ramble in woodlands, moorlands and mountains. We have got to see the difficulties of domestic life for so many country people which lie behind not a little of the rural beauty which we love, and we have got to realise the low standard of living and the lack of opportunity which the present scale of the organisation of much of our rural industry imposes. We must avoid the temptation to which I think some people are inclined to succumb of trying to keep the country as a sort of museum piece, instead of a vigorous, living organisation which must always be consciously and actively progressing and developing if it is not to become parasitic on the rest of the community.

### War Record of I.C.I.

SPEAKING at Glasgow on February 1st, Lord McGowan, Chairman of the I.C.I., lifted a corner of the veil which naturally covers a good deal of that concern's war effort.

The I.C.I. has recently been a target for criticism in this country and in the U.S.A. Its ramifications in British industrial life tend to magnify its relative size to equal those of similar concerns in both the U.S.A. and Germany. Both the General Motors and the United States Steel Companies, as well as the German I.G. Farbenindustrie, each employ about three times as many people.

Lord McGowan stressed the many aspects of the war industry

that the I.C.I. had assisted, from manufacturing petrol from coal to producing secret weapons, from making silage to manufacturing paint, from inventing self-heating cans of soups to producing drugs and medicines—to mention but a few items in a vast catalogue of work. "The I.C.I.'s war-time record has been freely recognised and appreciated by Ministers and their Departments," said Lord McGowan.

Turning to the future, the Chairman of the I.C.I. gave an assurance that his Company "would do its utmost to assist the Government in creating the World of Plenty."

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# The Bookshelf

**Men Who Make The Future.** By Bruce Bliven. (The Pilot Press, 1943; pp. x + 194; 8s. 6d.).

MR. BLIVEN is a journalist of some distinction who has been editor of a New York paper and a member of the staff of the progressive weekly, *The New Republican*. He has essayed a valuable and important task in writing this book which is the result of an extensive tour through the scientific institutions and laboratories of the United States. There he tried to discover not only what the scientists were doing but what problems they thought were important and what they themselves thought would be the impact of their work on the American social system. In a word he has attempted a synthesis of the American scientist's eye view of the world.

Mr. Bliven's enthusiasm is evident and his book makes entertaining reading. It is however quite obvious that in spite of the co-operation of a large number of distinguished scientists, the author has fallen into several traps of presentation and factual statement and has made a number of pronouncements which would not secure the support of scientists as a body.

His chapter for example on "Genius: Its Cause and Care" will be received with very mixed feelings and his recurrent tendency to devalue the contributions of Germany to science—even before Hitler—hardly bespeaks an attitude which would gain universal sympathy among scientists.

The book itself fascinates because of Mr. Bliven's ability as a writer and because of the fascination of his material. Of especial interest is the Chapter on Scientists in Uniform which however is a little disappointing since it fails to give a comprehensive picture of the way in which American science has been mobilised for war.

Mr. Bliven may however be forgiven all these faults. The one which will inevitably strike the British Scientist who reads this book is the extraordinary naiveté which Mr. Bliven displays in his discussion of the relationship between science and the social system. It is amazing that after so close a contact with political journalism, Mr. Bliven—perhaps reflecting a more generally held mental attitude—should be only at the beginning of problems which—while quite obviously not solved in Britain—are almost universally understood in their essentials by British scientists. Perhaps because of our much more restricted finance for British Science we have been compelled to a closer study of social problems, but the problems themselves are universal and will inevitably arise in all countries having a level of industrialisation sufficiently high to warrant the development of a large scientific profession. D.S.E.

**Evolutionary Ethics.** By Julian S. Huxley. (O.U.P., London, 1943; pp. 84; 2s.). ETHICS is a social phenomenon. One is therefore relieved to learn, after reading some thirty pages of this lecture, that it is

not an attempt to explain ethics in terms of merely biological evolution—evolution is taken in its broadest sense, including the evolution of human societies. Dr. Huxley's thesis briefly is that the evolution of the universe from primitive matter to the present defines a direction that must be regarded as progress and that ethical systems must be designed to encourage that progress. He applies the thesis to present problems by a train of deductions leading to such conclusions as "social organisations should be planned, not to prevent change . . . but to encourage it," and "it should now be regarded as immoral to leave any human being below certain standards of physical and moral welfare and development."

One feels somewhat surprised at Dr. Huxley's assumption that this view of ethics is essentially new. Surely the evolutionary viewpoint has been adopted and developed by many progressive thinkers from Karl Marx onwards, who have defined their ethics accordingly, often reaching much more concrete conclusions than Dr. Huxley does within the admittedly limited range at his disposal. But apart from this small reservation, the lecture makes stimulating reading at a time when all ethical considerations are necessarily subject to re-evaluation. S.L.

**Statistics.** By L. H. C. Tippett. (The Home University Library, 1943; pp. 184, + diagrams; 3s.)

The full possibilities of democratic government cannot be realised till all citizens are compelled to judge the facts on which political decisions must be based. In a country of fifty million people such facts must be largely statistical. Therefore true democracy requires that every citizen shall have some knowledge of statistics. Unfortunately, but a minority of our people are so equipped. This book may well help to increase their numbers.

It is a competent, though not inspiring, outline for the layman of statistical methods, the sort of material statistics can handle, the sort of conclusions it can reach. It shows, for example, how correlations can be used to demonstrate that in determining the size of our home-grown wheat crop between 1920 and 1938 "economic and political causes were more important than . . . technical causes and the weather"—a vital conclusion for future action. Impartially it also points out the severe limitations of statistics as a method of drawing conclusions for deciding policy.

The author makes certain recommendations for the better future use of statistics: for example, that there is "an unanswerable case for a central department to secure the efficient collection and publication of official statistics and avoid inconsistencies, overlapping, and waste". He concludes on the theme with which this review opened: "I look forward to the day when statistics will occupy a place in education only a little way behind arithmetic . . . and such general intro-

ductory books as this will become obsolete." S.L.

**Russian Made Easy.** By Moray Williams. (Frederick Muller, London; 1s. 3d.).

It is becoming increasingly important for scientists to be able to pick their way through journals published in the U.S.S.R. and the lack of a suitable scientific dictionary of Russian is becoming strongly felt.

Mr. Williams has done something to minimise the difficulties of the Russian language by his publication of this little book. It cannot and does not pretend to be a course in Russian but it will serve a very useful purpose in getting the timid learner over the first obstacle of the Russian alphabet and its pronunciation, as well as introducing him to the grammatical principles of the language and some useful colloquialisms. After such an appetiser many will feel capable of tackling a more solid helping. D.S.E.

**Rutherford of Nelson.** By Ivor B. N. Evans. (Pelican Book's Ltd.; pp. viii + 232; 9d.).

THE life of Lord Rutherford who made his way from the backwoods of New Zealand to the highest possible academic honours, and from a small ill-equipped laboratory to one of the most famous scientific institutions in the world is fit material for any biographer. Rutherford as a man stands out from Mr. Evans' pages with all his originality of mind and strength of character, but it cannot unfortunately be said that the author has done full justice to his subject. The narrative is of sufficient strength in itself to withstand severe handling, and it must be allowed to Mr. Evans that his handling is competent enough. What does however appear in quite a number of instances is that the author is not master of the technical details and principles which he must necessarily expound. Small but significant errors of fact and what is more important, of principle, mar the pages of what might have been a first class work. The author would have been well advised in preparing his book for republication as a Pelican to undertake a close revision in collaboration with a scientist specialising in atomic theory. D.S.E.

**Travel in England.** By Thomas Burke. (Batsford, 1943; pp. i-vi + 154, + 93 ill.; 10s. 6d.).

LEISURELY travel usually connotes slow jogging along in comfort, whether by road, rail or river. Nowadays travelling is still a slow business, but far from comfortable. Nonetheless I found this book a fascinating companion on a longish journey covered at an average speed of 15 m.p.h. In the sense of time there was an apparent affinity with the atmosphere of this book.

Thomas Burke, as in his previous subject-reviews, has done an admirable piece of work, both literary and pictorial. The story of the evolution of wheeled locomotion in Great Britain is well told. P.V.D.

# Far and Near

## New Year's Honours

THE New Year Honours List reflected the importance of the part that scientists and technologists are playing in the war effort. Among the principle awards of interest to our readers were the following:

### Knights

PROFESSOR J. C. DRUMMOND, Scientific Adviser to the Ministry of Food; PROFESSOR F. L. ENGLEDDOW, Professor of Agriculture, Cambridge University; DR. J. J. FOX, Government Chemist; PROFESSOR F. R. FRASER, Director-General, Emergency Medical Service; DR. T. R. MERTON, one of the Ministry of Production's three Scientific Advisers.

### K.C.V.O.

SIR HAROLD HARTLEY, Chairman of the Fuel Research Board.

### C.B.E.

MR. W. A. AKERS, a Research Director of the D.S.I.R., on loan to the department from I.C.I., Ltd.; DR. A. N. DRURY, lately a member of the scientific staff of the Medical Research Council; DR. W. H. GLANVILLE, Director of the Road Research Station, D.S.I.R.; MR. N. E. ROWE, F.R.A.E.S., Director of Technical Development, Ministry of Aircraft Production.

### O.B.E.

MR. K. PRASHAD, Principal of Patna Science College; MR. A. F. MACCULLOCH, F.I.C., Chief Advisory Chemist, Officer of the Director-General, Indian Medical Service; DR. J. E. MACKENZIE, Emeritus Reader in Chemistry, Edinburgh University, where he is also University Adviser to Indian students; MR. G. PEACE, F.I.C., Chief Inspector of Explosives in India; MR. F. R. JOHNSON, F.I.C., M.Sc., Government Chemist, Gold Coast; PROFESSOR C. H. BEST, Professor of Physiology in Toronto University, and co-discoverer with Banting of Insulin; DR. A. JAKES, D.Sc., F.I.C., Superintendent of Royal Ordnance Factory; MR. J. KING, Superintending Chemist, Government Chemist's Department; DR. J. G. KING, Director of Gas Research Board, D.S.I.R.

### M.B.E.

DR. DAVID SHOENBERG, Head of an extramural research team, Royal Society Mond Laboratory; MR. E. J. SMITH, a junior Scientific Officer attached to an operational research section of the Ministry of Aircraft Production; LIEUT.-COL. HAIDER KHAN, Professor of Chemistry, Aligarh Muslim University; MR. DURAI SWAMI NARAYANAMURTI, Dehra Dun Forest Research Institute.

## Preventing Bread Going Mouldy

IT is becoming a widespread practice in the United States for small quantities of salts of propionic acid to be added to foodstuffs such as bread, cheese and butter in order to prevent the growth of moulds.

## Research in Australia

THE sixteenth annual report of the Australian Council for Scientific and Industrial Research gives a good measure of the demands that are made upon scientists by a community at war. In many fields, such as chemistry and metallurgy, the problems which the Australians are having to investigate are similar to those which have arisen in dozens of other countries during the war, and for that reason a full abstract of the report would have but little novelty for the ordinary reader. The work done by the biologists is rather more interesting, because it is less familiar. For instance, investigations have been carried out into the use of so-called "inert" mineral dusts for killing insects. (A similar technique, readers may recall, is being studied in London, at the Imperial College of Science and Technology). The Australian experiments show that the mineral magnesite when applied in the form of powder to wheat grain at the rate of as little as 4 oz. a bushel confers a very real degree of protection from the attacks of the two species of grain weevil belonging to the genus *Calandra*. The dust is effective for as long as a year.

Work is being done with regard to the biological control of insect pests by means of parasites. One of the insects which Australian entomologists are trying to eliminate is the cabbage white butterfly, which has become a pest throughout south-eastern Australia. To combat it two natural parasites have been introduced from overseas; they are the braconid wasps *Apanteles rubecula* and *A. glomeratus*. The former, brought over from England, is found capable of parasitising 39 per cent of the pest insect population. The other parasite, received from the Dominion Parasite Laboratory at Belleville, Canada, is also being bred prior to its release in Australia. *A. glomeratus*, it may be noted, was introduced into New Zealand some time ago, and has proved an effective agent of biological control.

The possibilities of controlling the spread of the St. John's Wort (*Hypericum perforatum*) by means of insects is also being studied. A leaf-eating beetle, *Chrysolina hyperica*, which is capable of causing considerable damage to the plant had been distributed from various centres and is now found to be spreading naturally. At the points where the insects were originally liberated the host plants in the vicinity already show signs of extensive attack and leaf-stripping.

## New Branch of Academy of Sciences

A Western Siberian branch of the Academy of Sciences of the U.S.S.R. is being organised by a scientific mission despatched by the Academy, which aims to establish four institutes in the city of Novosibirsk, for chemistry and metallurgy, mining, and geology medicine and biology and transport, and power, respectively.

## Anti-Malarial Substitute

A little yellow tablet the size of an aspirin is saving the lives of hundreds of thousands of Allied troops who are fighting in areas where malaria is proving as formidable an enemy as the Axis. The names of this life-saver is Mepacrine—the only known substitute for the anti-malarial properties of quinine. Practically overnight it assumed high priority among the weapons of war. The territorial loss of Java was far outweighed by the loss of the valuable cinchona trees which gave the Japs control over the source of 95 per cent of the world's supply of quinine.

Mepacrine had been discovered and tried out prior to 1939. Weight for weight, compared with quinine, mepacrine is five times more effective and its dose is correspondingly lower. It has proved itself valuable not only in the treatment of malaria, but in its prevention. An encouraging feature of production in this country has been the co-operation between the big manufacturing chemists who agreed to pool all their resources. Thirty-three chemical processes are involved in its manufacture, and some 250 tons of raw materials are necessary to produce one ton of mepacrine. But 1,500 million tablets have gone to the Services and there are adequate supplies for the troops who require them. Collaboration between British and United States manufacturers has produced mepacrine on such a scale that both countries are now providing this equivalent of more than double the output of quinine from Java in any year.

## Sir John Drummond on Food

THE series of four lectures which Sir J. C. Drummond, scientific adviser to the Ministry of Food, delivered at the Royal Institution recently attracted a good audience; the same people, it seemed to our London correspondent, turned up to each lecture with a regularity as remarkable as that with which the food correspondents of the newspapers avoided these important talks on the scientific aspects of food.

Sir John indicated where gaps exist in our scientific knowledge; for instance, we do not know the protein requirements of the human body. While we are able to synthesise certain amino-acids (such as glycine, alanine, tyrosine, cystine), other amino acids (e.g. tryptophane, lysine, leucine) are indispensable and must be provided in the food. Results obtained from feeding experiments on rats have largely been confirmed by remarkable experiments done by two groups of U.S. scientists; in these tests, human volunteers lived for days on diets containing no protein, being fed on scientific diets consisting of starch, fat, mineral salts, vitamins and various mixtures of amino acids. From this work emerged the conclusion that in respect of amino-acids man acted as if he were a large rat.

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The possibilities of better protein of wheat flour of protein mixed with protein counterbalancing mixture was to skim the minerals, quantitatively iron and calcium the body, and its passage iron is substituted then found to 20% of absorbed, sorption iron but in a no trace that there comes into in iron, and the iron in His le food tech aims would quality of least interability, et freeze" w would ente chain of necessitate refrigerato consumer. effect on for instance Sir John dehydrated the war the comm dehydrated time and regard to the though their affect their prep present dr made-up d therefore c meat. Dr which wer instance th enable the to be sent of protei the quality lie, he sup dielectric method (a dried bloo the applic sublimatic the quality product w tins conta oxidation The las food educ which the were due population eating m hundreds strongly a efficiency

The speaker then drew attention to the possibilities of diet in order to get a better protein balance. For instance wheat flour was a relatively poor source of protein; yet if 15 parts of soya were mixed with 85 parts of wheat flour the protein deficiency of the flour was counterbalanced, to the extent that the mixture was comparable in feeding value to skim milk powder. With regard to minerals, we did not yet know the quantitative requirements for potassium, iron and calcium. The entry of iron into the body, for example, was not understood. Its passage can be followed if radio-active iron is substituted for ordinary iron; it is then found that in an anaemic person up to 20% of the iron in the diet can be absorbed, and a similar degree of absorption is shown by pregnant women, but in a normal person there is practically no trace of absorption. This suggests that there is some mechanism which comes into play when the body is deficient in iron, and which proceeds to "drag" the iron into the body.

In his lecture about the future trends of food technology, Sir John said that the aims would be to maintain the nutritional quality of the fresh produce, with the least interference with appearance, palatability, etc. He predicted that "quick-freeze" would be more widely used; this would entail a great re-organisation of the chain of distribution, for quick-freeze necessitated the storage of food in refrigerators until that food reached the consumer. This process has the least effect on foods—less than with canning, for instance.

Sir John then discussed the future of dehydrated foods. He thought that after the war the most promising product from the commercial point of view would be dehydrated potatoes, which save cooking time and require no peeling. With regard to dehydrated cabbage and carrots, he thought that the public would retain their affection for the raw vegetables and their preparation in various forms. At present dried meat could only be used in made-up dishes such as shepherd's pie and therefore could not compare with ordinary meat. Dried fish could be used in areas which were short of fish and meat; for instance the dehydration technique would enable the fish of Africa's lakes and seas to be sent to wherever there is a shortage of protein. Possible improvements in the quality of dehydrated products might lie, he suggested, in the development of dielectric heating and the vacuum drying method (as used in the preparation of dried blood, where freezing is followed by the application of a high vacuum causing sublimation of the ice). With dried eggs, the quality would be maintained if the product was vacuum-packed or sealed in tins containing nitrogen which prevents oxidation of the dried material.

The last lecture was concerned with food education. Some of the difficulties which the Ministry of Food had to face were due to the fixed food habits of the population; for example, the tradition of eating much meat went back many hundreds of years and had become strongly associated with ideas about the efficiency of work. He thought that

middle class people had been affected by the Ministry's recommendations, but the poorer people were only just beginning to be touched by it.

### Synthetics and Rubber Requirements

In a survey issued last month by the Federation of British Rubber and Allied Manufacturers Associations, the American manufacture of synthetic rubber is described as being one of the colossal achievements of the war.

"While it is agreed that synthetic, as we know it at present, does not yet possess the same qualities as natural rubber did before the war," continues the report, "it is recognised that in time synthetic rubber may be as good as natural. Samples produced by representative British manufacturers have been issued to all important users after the manufacturers themselves had carried out numerous factory experiments and circulated the reports on them to one another. The behaviour of synthetic rubber is now being observed on the bombers which go to Berlin, in R.A.F. dinghies, in the Navy's hose, depth-charge tubing, and the rubber used for water-tight doors, in the Army's respirators, capes and coats for dispatch riders; in ebonite at radiolocation (radar) stations; hose for the N.F.S.; belting for coal mines. Synthetic rubber has even been tested out in football bladders. The switch-over is already well advanced. The new Barrage balloons are made largely of synthetic rubber, and they are going on to it almost entirely. In a few weeks' time there will be no natural rubber at all in respirators. The cable industry is using only a quarter of the natural rubber it did before the war. Synthetic rubber is a boon to dairy farmers for it is immune to lactic acid, which causes natural rubber to perish. To sum up, research workers have been so successful in their efforts to substitute synthetic rubber for natural that, early in 1944, the whole output of the British rubber industry will consist of three-quarters of synthetic to only one quarter of natural rubber."

### Unique Royal Society Meeting

For the first time since its formation in 1662, the Royal Society has held a meeting outside Britain. This event occurred last week when the Indian Science Congress, meeting in New Delhi, resolved itself into a meeting of the Royal Society. Professor A. V. Hill, secretary of the Royal Society, who is at present advising the Government of British India on scientific matters, was present. Two recently elected F.R.S.'s—Dr. H. J. Babha and Sir Shanti Swarup Bhatnagar—undertook the obligations of fellowship and signed their names on a sheet of parchment, which will be incorporated in the Society's membership book.

Among those who addressed the Congress was the Viceroy, Lord Wavell, who spoke of the necessity of enlisting the help of scientists to control the genii they had raised, and to bring order into this new world, for which the scientists were so largely responsible. He also mentioned the fact that his great grandfather was "quite a distinguished scientist," who discovered a mineral which Sir Humphry

Davy named "wavelite." (Wavellite consists of hydrous aluminium phosphate and has the formula  $4\text{AlPO}_4 \cdot 2\text{Al}(\text{OH})_3 \cdot 9\text{H}_2\text{O}$ . It was first observed in the eighteenth century by Dr. W. Wavell in the slates at Filleigh, near Barnstaple.

### Seaweed Research in Eire

EIRE, like most other countries, has been faced with serious shortages of various materials, and much of the attention of her scientists has been directed towards relieving such deficiencies. The Industrial Research Council's report for 1942-43 reveals, for instance, the amount of work that has been done in order to meet the shortage of agar, which besides being important industrially, is essential for the practice of bacteriology. A complete survey of native seaweeds growing on the west coast of Eire has now been made under the direction of Miss Maurin de Valera. This has revealed beds of various useful species in Galway, Clare, Kerry, and Cork, and a process for the extraction of agar from them has been developed by Dr. Barry under the supervision of Professor Dillon of University College, Galway. Production of agar-agar on a limited scale has been already started by one commercial firm, and very favourable reports on the suitability of this product for bacteriological work have been received.

### Personal Notes

DR. R. ALUN ROBERTS, independent lecturer in agricultural botany in the University College of North Wales, and until the end of the year executive officer of the Caernarvonshire War Agricultural Committee, has taken up the duties of his new appointment as H.M.I. for rural education in Wales under the Board of Education.

DR. G. C. ANDERSON, secretary of the British Medical Association since 1932, died in London last month (January) at the age of 64. In 1942 he was appointed to the medical advisory committee set up to advise the Ministry of Health on medical problems relating to the health of the people.

The late PROFESSOR A. A. READ, whose death was announced in DISCOVERY last November, left £29,873. His bequests included £3000 to University College of South Wales, Cardiff, of which he was Emeritus Professor of Metallurgy, for a post-graduate research studentship in metallurgy, and £3000 to University College, Exeter, for scholarships in memory of his father. The rest of the money is to go to University College, Cardiff, for the Students' Union building.

PROFESSOR H. W. FLOREY, distinguished for his work in connection with the preparation of penicillin and its administration, has gone to Russia, where he will give Soviet medical men the benefit of his wide experience with regard to the use of the drug for the treatment of battle wounds. With Professor Florey is DR. A. G. SANDERS, who has assisted him

with much of the research on penicillin. The American members are PROFESSOR A. BAIRD HASTINGS and DR. MICHAEL BORIS SHIMKIN. Professor Baird Hastings is attached to the Harvard Medical School and is a specialist on dermatology.

The death occurred on January 1 of DR. FRANK LEE PYMAN, F.R.S., director of research, Boots Pure Drug Co., Ltd., at the age of 61. A graduate of Manchester University, Dr. Pyman early became an outstanding personality in the realm of chemical research. Much of his work was in connection with the constitution and synthesis of the active constituents of natural products, notably various alkaloids, and his work in chemotherapy included research on organic arsenicals, substituted amino-alkyl esters, and acid amides. Became an F.R.S. in 1922.

MR. R. W. MARSH, of the Long Ashton Research Station, has been elected president of the Mycological Society.

DR. W. W. C. TOPLEY, M.D., F.R.S., a distinguished bacteriologist, an hon. physician to the King, and from 1941 secretary of the Agricultural Research Council, collapsed and died on January 21 after attending a meeting of the council in London yesterday. He was a member of the War Cabinet Scientific Advisory Committee and of the Colonial Research Advisory Committee.

DR. BLODWEN LLOYD, M.Sc., Ph.D., who for the past two years has been woman-power officer on the District Man-Power Board, Glasgow, has been appointed to the staff of the British Council as administrative secretary in the science department and as liaison officer on scientific films between the Council's science and film departments.

Her chief in the science department will be Mr. J. G. Crowther, secretary of the Council's Science Committee and director of the department. As administrative secretary she will be responsible for the management of engineering correspondence and the supervision of the distribution of engineering abstracts overseas.

#### Conference on X-Ray Analysis

THE third Conference on "X-Ray Analysis in Industry" has been provisionally arranged to take place in Oxford on March 31st and April 1st under the auspices of the X-Ray Analysis Group of the Institute of Physics. Details are available shortly upon application to Dr. H. Lipson, Crystallographic Laboratory, Free School Lane, Cambridge. The conference will be open to all interested but it may be necessary to limit the number of non-members of the Group for whom accommodation can be provided.

#### Scientists at F.B.I. Conference

AMONG the recommendations made in the F.B.I. Report on Industry and Research was one suggesting the establishment of an organisation whose principal objects would be to stress continuously the need

for industrial research and to promote and foster it in all possible ways.

The form and functions of this suggested organisation were discussed at a recent Conference summoned by the F.B.I. and attended by representatives of the Royal Society, the Department of Scientific and Industrial Research, the Universities, and the Research Associations. A full discussion took place and a sub-committee was appointed to inquire further into the subject and to report back.

#### Wilbur Wright Lecture

SIR ROY FEDDEN has accepted the invitation of the Council of the Royal Aeronautical Society to give the thirty-second Wilbur Wright Memorial Lecture. The subject of the lecture will be delivered next May. The Wilbur Wright Memorial Lecture is the most important aeronautical lecture of the year, and to be asked to deliver it is regarded as a great distinction.

Sir Roy Fedden, formerly chief designer of the Bristol Aeroplane Company's Aero-Engine Division, is one of the greatest authorities on the sleeve-valve engine. He was primarily concerned in the development of a long line of successful Bristol engines.

#### Science and Animal Husbandry

LAST month at a meeting held at the London School of Hygiene and Tropical Medicine a new society called the British Society of Animal Production was set up. It aims to link together scientific workers and others particularly interested in animal husbandry and production. A provisional committee, with Dr. John Hammond, of Cambridge, as chairman, was appointed en bloc to carry on the work of the society, the other members being Dr. A. D. Fowler, Mr. Alec Robson, Mr. James Macintosh, Professor W. C. Miller, Mr. W. A. Stewart, and Professor R. G. White, with Dr. J. E. Nichols as secretary-treasurer.

#### Shipbuilding Research

An organisation for the development of all branches of research associated with shipbuilding, marine engineering and ship repairing is being formed by the British shipbuilding industry. This step has been taken after consultation with the Department of Scientific and Industrial Research, the Admiralty, the shipowners and other interested organisations. The British Shipbuilding Research Association will consist of a Research Council, elected by the Shipbuilding Conference, which will finance the Association and will be responsible for its general conduct and policy. The D.S.I.R. will be represented on the Council. A Research Board is also to be constituted on which there will be a wide representation of technical and other interests.

#### Aeronautical Science

THE Minister of Aircraft Production's statement in Parliament recently that preparations are being made for the establishment of a school of aeronautical science will be generally welcomed, for the need for such an institution has long

been appreciated. Sir Stafford Cripps stated that the Aeronautical Research Committee had made a report, the main recommendations of which had been approved in principle by the Government. With the agreement of his colleagues he had appointed an inter-departmental committee, under the chairmanship of Sir Roy Fedden, to prepare and submit detailed proposals for the establishment of a school of aeronautical science within the general framework of these recommendations.

#### Television Development

THE Government has appointed a Television Development Committee to consider and make recommendations for the development of television in Britain after the war. The chairman of the committee is Lord Hankey, and the other members are: Sir Noel Ashbridge and Mr. Robert Foot (representing the B.B.C.); Sir Raymond Birchall and Sir Stanley Angwin (representing the G.P.O.); Mr. R. J. P. Harvey (representing the Treasury); Sir Edward Appleton, secretary of the D.S.I.R.; and Professor J. D. Cockroft (representing the Ministry of Supply).

#### Dehydration of Cheese

A new method of dehydrating cheese has been devised by Mr. G. P. Sanders, according to *Food Industries*, United States. The inventor is Chief of the Division of Dairy Research of the Bureau of Dairy Industry. American cheddar cheese usually contains more than 33% of water, and there are several difficulties in dehydrating this material, including loss of fat content. Earlier methods consisted in processing the cheese into a milky paste which could be spray-dried, or grating skim milk cheese for drying and adding the fat after dehydration. With the new method only properly cured cheese, selected with particular attention to flavour and thoroughly cleaned, is used. It is grated, dried at room temperature to harden the surface of the particles, and then finally dried in some type of dehydrator. The dried flakes may be compressed into bars or cakes and are said to have good keeping qualities.

#### Proper National Food Policy

CONSIDERABLE interest attaches to the memorandum entitled "The Nation's Food" which the Labour Party has just published. This pamphlet was based on a memorandum which Sir John Orr was asked to prepare at the invitation of the Policy Committee of the Labour Party, although Sir John is not a member of the Labour Party—nor of any other political party. The views he expressed were so closely in accord with the Labour Party's views that the memorandum was adopted, with Sir John's consent and with a few minor alterations to which he agreed, as a statement of the party's policy.

#### Interchange

THE Massachusetts Institute of Technology and the Imperial College of Science and Technology are arranging to maintain, after the war, a regular interchange both of staff and of post-graduate students.

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# EDUCATION HANDBOOK

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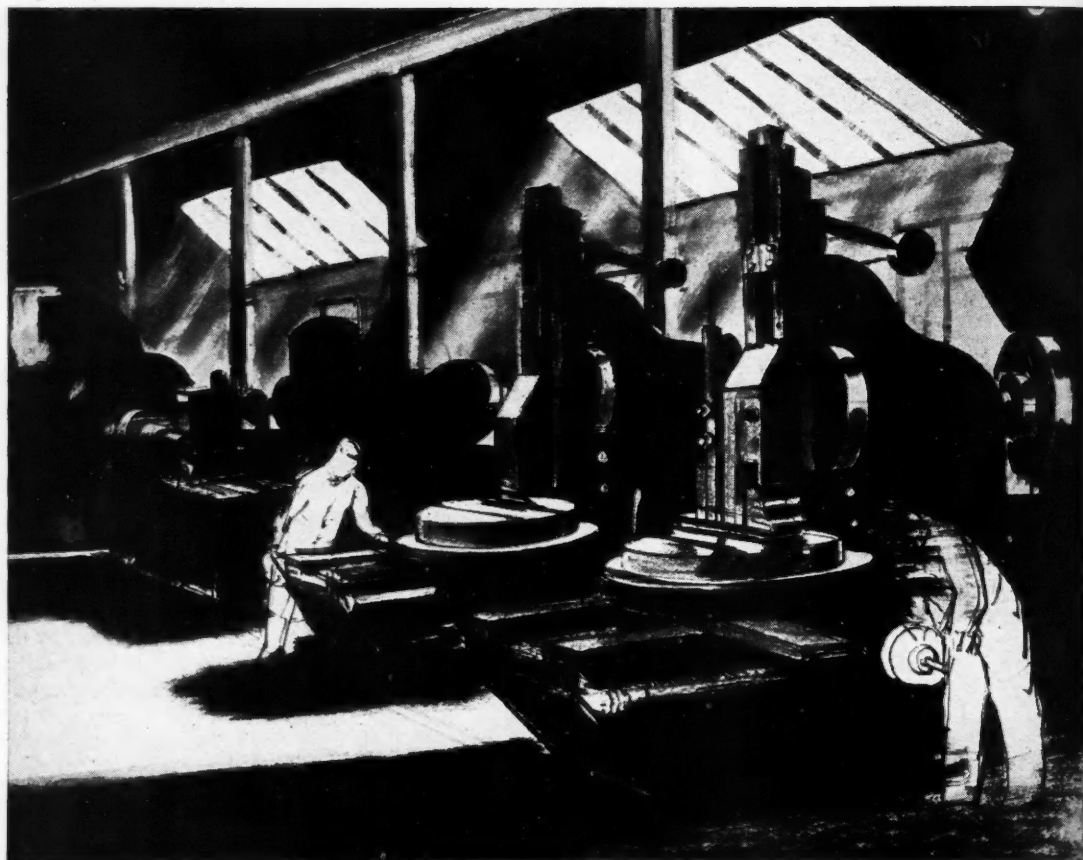
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the trichlorethylene process. Nor is the chemical industry content merely to produce trichlorethylene and its allied solvents: it has designed and made available special "degreasing" apparatus. British chemical research has led to developments in the heat treatment of metals, an example being the casehardening of steel which can now be performed simply and efficiently by means of baths of molten cyanide. It has also devised an easy method of carrying out the annealing of metal strip and wire by what is known as "bright annealing," so that the descaling of the metal by separate processes is avoided. Finally, it has made available a multitude of finishes, such as electro-plating and rust-proofing, which are essentials to modern engineering practice. The relationship between the chemist and the engineer is a happy one. The chemist contributes to improvements in the machine-shop. The engineer responds by helping the chemical industry to solve its problems and thereby to advance the value of the service it gives to Industry as a whole.



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